METAL INDUSTRY

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Editorial

Platers' Research Fund

The Research Fund of the American Electro-Platers' Society and the projects supported by this Fund have now been in operation for several years. No better answer to the constantly recurring question, "What is research doing for the plating industry", can be made than Dr. William Blum's summary given at the recent meeting of the Boston Branch of the A.E.S. (reported on page 94 of this issue).

To date the research on electroplated coatings on steel has cost about $50,000, of which the A.E.S. has contributed about $20,000, the National Bureau of Standards about $20,000, manufacturers about $5,000; the balance consisting of miscellaneous contributions of time, traveling expenses, etc. No matter how callous we have become to money figures (we now think in billions!) fifty thousand dollars is a considerable sum of money. What has this particular research done for the industry?

The outstanding result has been the development of tentative specifications (which will eventually become standard) for electroplated coatings, copper, nickel, chromium, zinc and cadmium on steel. It is universally admitted that as a result the electroplating on automobiles has been vastly improved; some say that it is now good for the life of the car. Let us suppose that only 1,000,000 cars have been so improved. A simple calculation shows that the cost, therefore, has been 5 cents per car.

The above question is, therefore, answered, completely.

The American Electro-Platers' Society is now seeking funds for the current year's operations of the Research Fund. As W. M. Phillips says, it does not solicit "contributions" but "investment". No better investment is possible than an expenditure of 5 cents per automobile which adds years to the life of the plated finishes; which establishes in the eyes of the public the beauty and permanency of plated finishes and which makes the electroplating industry sure of its future.

Where to Find New Business

An "industry" which has been growing unobtrusively, but nethertheless steadily to an astonishing volume, is the staging of exhibits of equipment and supplies used in specific industries. In fact many manufacturers have begun to feel that there are too many "shows" and that the expense of displaying their products is becoming burdensome.

Nevertheless, the value of these shows, if held at reasonable intervals, is undeniable. METAL INDUSTRY has therefore, instituted a new feature—regular reports of all shows, expositions and conventions in all allied industries whose products use metals and metal finishes, and where metals and metal finishes are displayed. A surprising number of new leads and new ideas can be gained from visits to these shows. For example, the metal products manufacturer may find that his output can be used in business machines, in motor boats, in heating and ventilating equipment and in a variety of other fields which he did not suspect would provide him with customers. Plated and lacquered finishes are now used on such prosaic installations as air conditioning equipment.

In this new section (see page 101 of this issue), we hope that our readers will find stimulation to go after new types and lines of work and find new outlets for their output. We know that today business can be obtained only by the most active and energetic sales effort.

Business Today

Business today needs no index figures to tell us about its condition. Nevertheless our knowledge can be clarified and certainly our confidence can be fortified by the fact that the business index has been rising for the past two or three weeks. To be sure we are in a normally dull season. Also we expect no miracles during the first quarter. We are pleased, however, by the steady progress of steel operations which have increased from a low of less than 20% to a present rate of 33%.

Reports from the nerve center of the country—Washington—could be more encouraging. The atmosphere is still too political. We cannot believe, however, that politics can be carried so far as to become suicidal. We are ready, therefore, to venture the prediction that when and as (not if) Washington gives its active aid or at least removes some of the hobbles from business, we shall go ahead.

The year is young. In spite of the disappointing ending 1937 was good. In spite of a disappointing beginning 1938 should also be good.

Fabricating Properties of Nickel Silver as Affected by its Chemical Composition

Laboratory and plant experiments show that in 18% nickel silver intended for severe cold deformation, the zinc content could not exceed 20% if a smooth surface is required.

By **DR. B. EGEBERG and N. E. PROMISEL**
International Silver Co., Meriden, Conn.

NICKEL-SILVER is brass to which nickel has been added and a wide variation in chemical composition may be had depending upon the analysis of the brass and upon the nickel content. The colors of the alloys likewise vary from faded yellow to hues of yellow-white and blue-white.

The white alloys of nickel-silver, especially those with good ductility, are especially attractive to several industries and this article deals exclusively with that class. The usual composition is as follows:

Nickel 15-20%
Copper 62-67%
Zinc remainder

During the last 10 years, copper has fluctuated between 5¼ and 22 cents per pound, (monthly average), and in times of high copper prices there has been a great incentive for makers of nickel-silver to lower the copper content of the alloy, increasing the zinc content correspondingly. The metal is sold and bought on the basis of its nickel content, so that this ingredient must, perforce, remain unchanged. This article summarizes the affect of variations in the copper:zinc ratio upon the annealing, hardness, and fabricating properties of nickel-silver containing approximately 18% nickel.

Laboratory Experiments

The raw materials used for preparing the alloys were electrolytic nickel, wire bar copper and electrolytic zinc. A gas-fired crucible furnace was used, and conventional melting and casting practice followed. The resulting ingots were all sound, measured 3 inch in width by ¾ inch in thickness, and weighed about 7 lbs. each. Table 1 shows the actual analyses of the ingots together with their Rockwell Hardness.

Fig. 1 is plotted from the data contained in Table 1 and shows that the hardness of cast 18% nickel-silver steadily and slowly increases as the zinc content is increased up to about 30%. At this point there is a rather sharp break in the curve and any further increase in the zinc content causes a rapid increase in the hardness of the cast ingot.

After the surface had been removed by scalping, the ingots were cold rolled in easy passes to approximately 10, 20, 35 and 50 per cent reduction, at which stages samples for testing were taken. Alloy A-10 (54 per cent zinc) was badly ruptured during the first pass between the rolls and Alloy A-9 (42 per cent zinc) cracked after 20 per cent reduction. The remaining ingots maintained smooth, unbroken surfaces throughout the rolling. Fig. 2 (p. 63) shows the effect of cold rolling upon the ingots in question. It appears from these curves that the alloys with the higher zinc content harden the most.

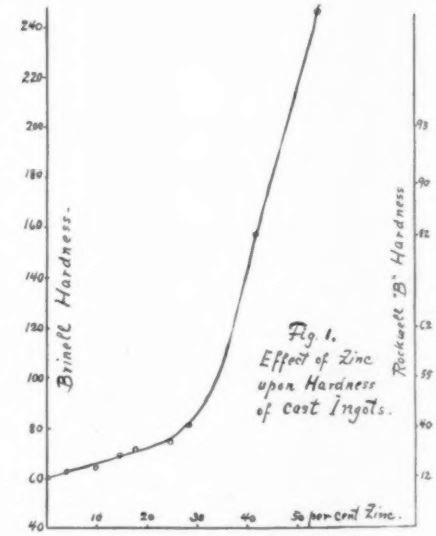


Fig. 1. Effect of Zinc upon Hardness of Cast Ingots.

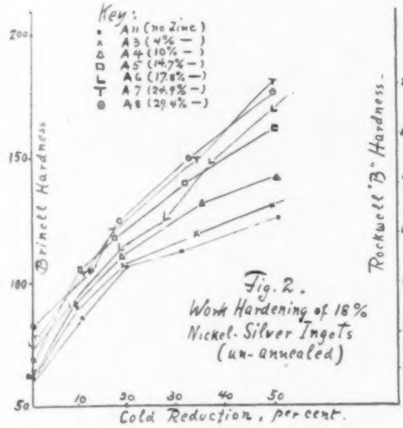
The slabs, after 50 per cent cold reduction, were approximately 0.35 inch thick. At this stage, four samples were cut from each slab and annealed at 1000°, 1200°, 1400°, and 1500°F.

In general, annealed 18 per cent nickel-silver of the standard composition (65 copper, 17 zinc) should have a hardness in the range B30-45 Rockwell and a grain diameter of .025-.037 millimeter. This is usually obtained

Table 1

Alloy	Copper	Nickel	Zinc (by difference)	Rockwell B Ingots as cast
A-11	81.0	19.0	0	12
A-3	77.0	19.0	4.0	15
A-4	72.3	17.7	10.0	16
A-5	66.3	19.0	14.7	26
A-6	64.0	18.2	17.8	29
A-7	56.6	18.5	24.9	34
A-8	51.6	19.0	29.4	42
A-9	41.3	16.9	41.8	82
A-10	29.8	16.1	54.1	100

In annealing in the range 1200-1250°F, which is in agreement with Table 2, (Alloys A5 and A6). When using this as a measuring stick for judging the remaining data of Table 2, one would say that the higher the zinc content in 18 per cent nickel-silver the higher should be the annealing temperature. Whereas, an alloy with 10 per cent zinc (A4) can be efficiently annealed in the range 1000-1200°F, the 25 per cent zinc alloy



(A7) would require 1400-1450°F. With still higher zinc content, this relation is broken. For example, for the 30 per cent zinc alloy (A8) there is no satisfactory annealing temperature, since a temperature even as low as 1200°F leaves the metal too coarse-grained for fabricating processes where satisfactory forming properties are required. At the same time an annealing temperature of 1500°F is hardly high enough to soften the metal sufficiently.

It shall be granted that conclusions like the above are more safely made on a smaller gage, after the metal has been rolled and annealed a few times so as to obliterate completely any effect of ingot structure. However, some judgment had to be made as to the best temperature to anneal the rolled ingots and in Table 3 are given the temperatures decided upon:

Table 3

Alloy	Annealing Temperature
A-11 no zinc	1250°F
A-3 4% zinc	1250°F
A-4 10% zinc	1250°F
A-5 14.7% zinc	1300°F
A-6 17.8% zinc	1300°F
A-7 24.9% zinc	1400°F
A-8 29.4% zinc	1250°F

After annealing as above, the slabs were again cold rolled to about 20%, 50% and 75% reduction (equal to 60%, 75% and 87.5% reduction of the cast ingot) taking samples for test at the mentioned stages. Fig. 3 illustrates the results which are quite similar to those of Fig. 2. The higher the zinc content (the lower the copper content) the greater is the increase in hardness after a given amount of cold rolling.

The cold rolled strips were again annealed preparatory to further cold rolling and the result substantiated the previous conclusions that:

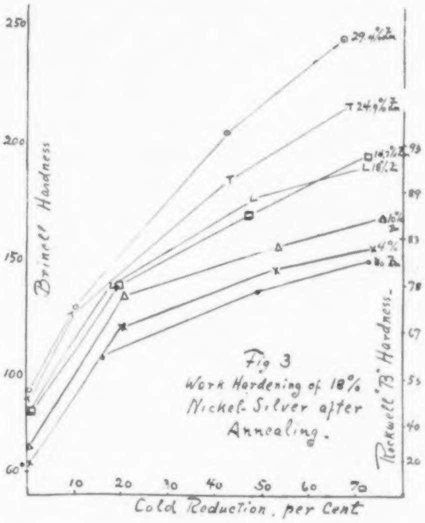
(1) The higher zinc content alloys work harder, faster and require therefore more frequent anneals. They require a higher annealing temperature in order to be softened sufficiently for further cold working.

(2) At the same time, the high zinc content alloys (above 25% zinc) require a low annealing temperature in order that the metal shall not become ruined by excessive grain growth which would interfere with deep drawing and general fabrication.

The above two requirements are obviously in conflict with one another and they set a limit to which copper can be replaced by zinc in an alloy of nickel-silver containing about 18% nickel. This limit does vary according to the purpose for which the rolled metal is intended, but for general purposes involving some forming and drawing the zinc content is best limited to 20% (with 18% nickel and 62% copper). For severe deep drawing purposes the zinc content may advantageously be less, say 10 to 15%.

Plant Experiments

The Laboratory experiments had indicated the danger of replacing copper to any great extent with zinc in an alloy of nickel-silver containing 18% of nickel. While rolling mills may manage successfully with alloys containing as high as 30% zinc without undue cracking and loss, the subsequent sheets and strips, when in the hands of fabricators, are liable to cause difficulties, as brought out in the first part of this article. On the other hand, it would seem that in many cases no ill affect might result from a moderate increase in the zinc content,



e.g. an increase from 18 to 24%, causing a reduction in the copper content from 64 to 58% when keeping the nickel content constant at 18%. This alloy was tried on a commercial basis and the unexpected and disastrous results are recorded below.

The "picking-up" of metals on cold rolls is a common phenomenon. Nickel-silver is no exception in this respect and rolls like those used in the grading of spoon blanks usually require polishing twice a day. This is especially true for those sections of the rolls performing the greatest reduction of the nickel-silver blank, such as at the tip of the bowl and at the tip of the handle, where the blank may be reduced up to 60% in thickness in one or in two successive passes. At these places especially the rolls become roughened in time by "picked-up" nickel-silver, the surface finally becoming so poor that the mill must be stopped and the rolls polished to avoid imprinting the roughness upon the surface of succeeding blanks. As stated, the rolls usually require polishing twice every day in order to main-

Table 2

Alloy	Rockwell B Hardness after annealing at 1000°	1200°	1400°	1500°	Diameter of grain in mm. after annealing at 1000°	1200°	1400°	1500°
A-11 no zinc	30	17	13	11	...	.030	...	...
A-3 4% zinc	30	17	15	12	...	.028	...	.070
A-4 10% zinc	36	29	26	18	...	.037	...	...
A-5 14.7% zinc	45	41	35	29	...	...	.040	.068
A-6 17.8% zinc	51	43	34	25	.013	...	.040	.055
A-7 24.9% zinc	62	53	44	37	.013	.027	.036	
A-8 29.4% zinc	65	58	53	48	.013	.047	.052	.080

tain the surface on the blanks smooth.

The dislodging of small particles of nickel-silver from the spoon blank on the cold roll may occasionally reach such dimensions that in order to maintain a smooth surface on the blanks, polishing of the rolls must be resorted to as often as every ½ hour. Such occasions have always puzzled the silverware maker who sometimes blames the rolls and sometimes the metal. The rolls are made from chrome steel hardened to 105 Shore and upon thorough investigation they have seldom been found to be the cause of the difficulty. On the other hand, metallurgists have had difficulty in pinning the blame on the nickel-silver though often a low transverse notched bend test shows reduced toughness in metal which picks up on the rolls. However, transverse weakness has been found in "cored" metal which may or may not roll to entire satisfaction. Likewise, small amounts of lead and tin (above 0.02 per cent) have been blamed as well as high iron and manganese contents. In one instance the hardness of the metal was blamed (Rockwell B55) as nothing wrong otherwise could be found either by chemical, microscopic, or spectrographic methods. Increasing the zinc content from 18 to 24 per cent, reducing the copper content correspondingly, has also caused severe picking-up on the rolls.

Usually the rolls are lubricated and water cooled. In most cases of pick-up it was found that cutting down the flow of water was helpful to a small degree.

We shall at this stage postulate that metal pick-up on cold rolls in excess of the normal amount is due to overstraining of the nickel-silver surface, causing microscopic or sub-microscopic ruptures, probably on the very surface of the metal only. Small, rough, and unlubricated surfaces are thereby brought in contact with the rolls under high pressure and under some sliding friction, in which cases metals may be expected to stick to one another extensively. This hypothesis we substantiate with photomicrograph No. 1 showing grain boundary rupture in the very vicinity of the nickel-silver surface after grade rolling. This metal caused an unusual amount of pick-up. Ordinarily, however, the rupture defies microscopic detection, probably because it is very fine indeed and also because it occurs on the very surface only of the rolled blank.

In this connection it may be stated that spoon blanks tapered towards both ends are rolled between one round and one graded roll so that sliding (due to difference in roll diameter) and severe surface strains in the blank are to be expected, especially at both ends where the reduction is the greatest.

The above hypothesis based on submicroscopic ruptures, which in exceptional cases become microscopic and even visual to the unaided eye, we claim to be a general all-embracing explanation, on the basis of which all

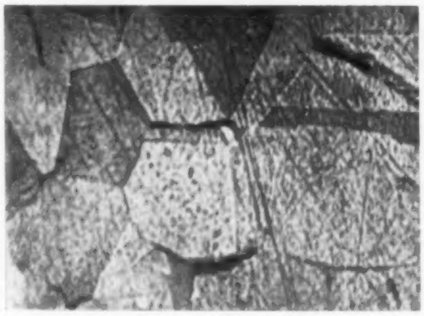


Fig. 4. Grain boundary rupture near nickel-silver surface after grade rolling

previous isolated observations concerning abnormal nickel-silver pick-up on the rolls can be co-ordinated as follows:

(1) As mentioned, excessive coring has occasionally in the past been blamed for causing pick-up on the rolls. From the standpoint of our postulate, this seems quite possible in that segregated areas, high in nickel or in zinc, work-harden rapidly during cold rolling. This, together with the reduced transverse toughness always associated with a banded structure, makes rupture likely to take place. It should be stated here that rolling of spoon blanks is across the grain.

(2) Tin and lead are both known to reduce the ductility of nickel-silver to the extent of cracking. Good rolling metal should not exceed 0.03 per cent of each though frequently it contains considerably more. It should be mentioned that tin is more harmful when small amounts of antimony are also present, as is the case when nickel-silver scrap has been contaminated with Britannia metal often used for ornaments on many articles made from nickel-silver. When visual cracking of the metal during rolling occurs, severe picking-up on the rolls has been observed. On the basis of our hypothesis, lesser amounts of the mentioned impurities would cause microscopic or even sub-microscopic cracking, probably extremely superficially only, but, nevertheless, small unlubricated surfaces would constantly be brought in contact with the rolls, thereby explaining pick-up on the rolls in excess of the normal amount.

(3) Iron and manganese contents higher than the usual amounts both produce metals which work harden more rapidly than normal nickel-silver and may, therefore, cause ruptures under the severe grade rolling conditions here discussed (30% to 60% reduction in one pass).

(4) Likewise, starting with an insufficiently annealed and hard metal (Rockwell B50 or above) may cause surface cracking and pick-up on the rolls.

(5) As has been mentioned before, reduction in the supply of cooling water has generally been found to help in minimizing pick-up on the grade rolls. From the standpoint of our hypothesis, this may be explained by the higher ductility of the metal at the somewhat increased rolling temperature.

(6) Finally, as has been shown by this article, an increase in the zinc content (lowering the copper content correspondingly) not only increases the hardness of the metal as cast and as annealed, but it also increases the work hardening properties of the metal.

Microscopic surface rupture during severe cold rolling seems, therefore, quite a tenable hypothesis to explain the severe pick-up on the grade rolls obtained with such metal. Enough of this metal was made (about ½ million pounds) to make the findings independent of contributory factors. It is, therefore, with reasonable assurance of correctness that we state that in 18% nickel-silver intended for severe cold deformation, where pick-up on rolls and tools is to be expected and where a smooth surface is of importance, the zinc content of the metal should not exceed 20% and preferably it should be less. Thus, there is removed the possibility of advantageously using for the above purposes an alloy richer in zinc, which possibility was indicated by the preliminary experiments.

The Resistance Welding of Aluminum

Spot, seam and butt welding. An important process in the fabricating of aluminum products.

By G. O. HOGLUND
Welding Developing Engineer, Aluminum Co. of America, Pittsburgh, Pa.

THERE are two principal reasons why industry uses resistance welding. First of all, resistance welding replaces mechanical joining, such as riveting, because it is stronger than the older method. Secondly, it is much quicker than other types of joining, and thus lends itself well to mass production, where cost is always a matter of consideration.

Because the area which is heated by resistance welding is so small in comparison with fusion welding, there is a minimum amount of surface distortion and the finished piece of work presents a neat appearance. The strength of the weld compares quite favorably with the strength of the material.

Resistance welding is divided into three forms: spot welding, seam welding, and butt welding. Discovered by the late great Elihu Thomson, its history goes back almost to the time when electricity was first harnessed to industry, and while it has been used on iron and steel for a great number of years, its application to aluminum and aluminum alloys has been relatively recent.

In spite of this newness, the resistance welding of aluminum has become an important fabricating process, because of the ever-increasing uses to which aluminum is being put, in the manufacture of which resistance welding plays a noteworthy part.

Spot Welding

Five points determine the success of spot welding aluminum alloys. The material and design of the electrodes must be carefully considered; the correct pressure must be applied by the electrodes; the design of the spot welding machine must fit the new material; the application of power must be timed correctly; and the surface condition of the material to be welded must be carefully prepared. Otherwise the resistance welding of aluminum is quite similar to practices prevailing for other metals.

Electrode Design and Material. Electrodes for spot welding aluminum must be of the highest practical conductivity because of the large currents required as the result of the relatively high conductivity of aluminum and its alloys. Pure copper would be normally the best available material, were it not for the fact that copper electrodes must have a hardness greater than that of pure copper. Special copper alloys with a hardness considerably greater than that of hard drawn copper, and with a conductivity of 80 to 90 per cent that of hard drawn copper, are the best known spot welding electrode materials.

Because a molten zone is formed between two aluminum alloy sheets in spot welding, the electrode design must be such that the area of high pressure and the area of current flow be kept at a minimum. At least one of the electrodes should establish a theoretical point of contact on its sheet. Satisfactory results are obtained with either a spherical or a conical head, the latter being the more commonly employed.

The cone of the electrode is machined at an angle varying from 7 to 12 deg., depending upon the type of work on which the electrode is to be used. The electrodes are machined from round rod and are secured in the electrode holder by means of a taper seat. The center of the electrode is drilled out to provide internal water cooling, and the design is such that the cooling chamber is quite close to the end of the electrode.

A number of machined electrodes are kept available, for it is sometimes necessary to change the tips several times a day. Because of their shape, they are easily removable and easy to install. The contacting surface should be cleaned from time to time. This is done with abrasive cloth held in the fingers. When this has been done often enough to alter the original contour, the electrode is removed for redressing. When an electrode is redressed, it is again machined, and not, as is the case with electrodes used for other metals, filed, for filing destroys the desired contour.

Normally two electrodes, each made with a 7-deg. cone, give satisfactory results, although various combinations may be employed. If it is desired that one of the two sheets to be welded be free from any markings, one of the electrodes may be flat. Cones with a

Fig. 1. Close-up view showing a spot welding machine at work on an aluminum airplane tank part.

Table I. Approximate Table of Machine Settings for Spot Welding Aluminum Alloys

Gauge B & S No.	Gauge In.	Time Cycles	Current Amperes	Tip Pressure Min. Lb.	Tip Pressure Max. Lb.
26	.016	4	14000	200	400
24	.020	6	16000	300	500
22	.025	6	17000	300	500
20	.032	8	18000	400	600
18	.040	8	20000	400	600
16	.051	10	22000	500	700
14	.064	10	24000	500	700
12	.081	12	28000	600	800
10	.102	12	32000	800	1000
8	.128	15	35000	800	1200

Note: A 7-deg. cone tip should be used for welding aluminum sheet, 10 ga. and lighter. An 11-deg. tip should be used on 8 ga. and heavier stock.

steeper angle, somewhere between 10 and 12 deg., are frequently used on material heavier than .100 in. thick.

Electrode Pressure-Applying Mechanism. There are many forms of mechanisms which may be used to bring electrodes together under pressure. Any design which provides a minimum hammer blow and easy and accurate pressure adjustment can be employed. Air operation is widely used, particularly on machines which handle many different types of work. A reducing valve and air receiving tank permit accurate and quick adjustment. The use of an air cylinder permits the adjustment of the electrodes to any desired position by a simple mechanical device.

Electrical Design of Spot Welding Machine. To perform satisfactorily, the spot welding machine for use with aluminum and its alloys must be capable of providing a sufficiently high welding current for the work in question. The machines designed for the spot welding of other materials are usually unsuitable because they do not meet this requirement.

The machines used with aluminum must be capable of supplying any desired secondary current up to the value representing the heaviest work which the machine is expected to handle. The proper relationship between work and current supply is shown on Table I above.

The current adjusting device should also have a large number of steps so that the current may be adjusted by small increments as accurately as possible. Most machines for welding aluminum can give such an adjustment by means of an auto transformer, which permits the welding transformer to be untapped and designed for low reactance at high current outputs. An auto transformer that has 20 to 25 equal steps from 20 per cent to full voltage is generally satisfactory.

Timing of the Power Application. The two types of timing equipment employed in the spot welding of aluminum and its alloys are (1) the full electronic type of equipment which synchronously applies and removes the power to the primary of the welding transformer, and (2) mechanical or electro-mechanical timers, usually non-synchronous.

The use of synchronous timing is necessary for the production of quality work, for such timing eliminates the unequal transients which exist for the first few half-cycles when the machine is energized non-synchronously.

Non-synchronous timers are satisfactory when used with common alloys and material having a thickness of .051 in. or greater.

Surface Condition of Materials. All aluminum alloys have a surface condition which is normally electrically different from that of the alloy itself. In order to obtain best results, this surface condition must be removed although that is not necessary with all non-heat-treated alloys.

When preparing surfaces for spot welding, it is important that surface heating be avoided, so that the metal is not alloyed with the tip material, or vice versa, for copper from the welding tips will reduce the resistance to corrosion of the joint if it is deposited on the spot weld.

Cleaning may be done, either mechanically or chemically, on all surfaces or only on those which contact the electrodes. Mechanical cleaning is accomplished by the use of emery cloth or by a motor-driven wire brush.

Where only a few parts are involved, surface cleaning can be most economically accomplished with a fine grade of brasive cloth, such as No. 240 Aloxite, with fine steel wool, or a fine scratch brush. In ordinary cases only the area to be contacted by the welding tips needs cleaning, but parts which have been heat treated in nitrate should have at least one entire faying surface well cleaned.

Fig. 2. Seam welding a milk cooler plate. The electrodes on the seam welder are two copper wheels, the bottom being the driver, the top the idler. The electrodes are cooled by a stream of water descending from the lower wheel.

When cleaning the surface by chemical means, a liquid etch may be used if the parts are small enough to be immersed in the liquid. Otherwise, a paste etch is employed, which is brushed on the desired areas, left for a short time, and then removed by washing off with water.

When using an etching solution, it may be applied by a paint brush. A satisfactory solution is composed of 2.9 lb. gum tragacanth, 80 lb. hot water, and 10 lb. of 30 per cent hydrofluoric acid. The gum tragacanth is first dissolved in the water, but as some grades of the gum do not dissolve readily, it is sometimes necessary to add 7.1 lb. denatured alcohol to accelerate the action. The alcohol has no effect on the cleaning properties.

A quantity of the solution is usually mixed and stored in a wooden barrel. For daily use, a quart or so of the mixture is removed from the barrel and kept in a paraffin-lined aluminum pan. Such precaution is necessary because an exposed metal container will not withstand the action of the hydrofluoric acid.

Rubber gloves should be used by the workmen when handling the etching solutions, for the solutions, though apparently harmless, produce painful burns which are difficult to heal. Such burns are particularly apt to occur under the fingernails. The use of goggles is also advocated.

The total etching time, which may be anywhere from 15 to 60 seconds, is determined by trial spot welding of the cleaned parts, for the condition of the surfaces of the parts to be cleaned is not consistent in the various alloys or even in various batches of the same alloy. The etch is removed from the work by washing in running water. Cold water is satisfactory, hot water is better because when it is used the surface dries more quickly.

Seam Welding

Fuel tanks, gas-tight containers, and vessels for liquid are often fabricated by seam welding. The process is similar to spot welding, but the electrodes, instead of being two machined copper alloy bars, are metal rollers. The current supply for seam welding is intermittent, producing a series of overlapping spots.

The rollers are copper alloy, and may be of almost any reasonable diameter. Their rims are either curved or V-shaped, corresponding to the spherical or conical contour of spot welding electrodes. An adjustable pressure mechanism is employed to bring the electrodes together under any desired pressure, and a motor drive is used to give the desired lineal speed of the rollers. Only one roller is driven; the other is an idler.

While there is a choice between synchronous and non-synchronous timing in spot welding, only the former is used in seam welding, because only through it can uniformity of successive overlapping welds be obtained. Such

Fig. 3. An example of spot and torch welding. This aluminum canoe was recently built to the customer's specifications in the Job Shop of the Aluminum Company of America at New Kensington, Pa.

timing is also a requisite from an electrical standpoint, for the alternate half-cycles of power must be perfectly balanced. This is not possible where non-synchronous interrupted power is employed, for it quite often causes a cumulative saturation in the welding transformer which at intervals makes welding impossible.

Alcoa 52S, which is an aluminum-magnesium-chromium alloy extensively used in making tanks, might well be used as an example to show typical and satisfactory adjustments on the welding machine. Machine settings for this alloy may be seen on Table II. From this table settings for other alloys may be approximated. The pressure is varied in accordance with the hardness of the alloy.

Electrical design, electrode material, electrode design and maintenance, and proper surface preparation are essentially the same as those discussed under "Spot Welding."

By changing the relation between the cycle adjustment and the lineal speed of the rolls, a seam welder may be employed in place of a spot welder for the production of intermittent seam welds. Results are the same, but the speed is much greater.

With a seam welder any desired number of spots may be made per inch at regular intervals if the machine is provided with a suitable range of timing and lineal speed adjustments.

Butt Welding

"Push" welding and "flash" welding are the two methods normally employed in making butt welds in aluminum alloys. "Push" welding is a term coined by aluminum workers; in the industry this method is generally referred to as "resistance butt welding."

In the first method, the two pieces to be welded are first clamped into dies and then their ends are pressed together. Current is applied, and after a certain number of cycles melting will occur at the juncture. Since pressure is maintained on the dies, the pieces move toward each other slightly as the melting progresses. When there is a sufficient amount of melted metal at the joint, the current is shut off, the pressure maintained until the molten metal freezes. Then the pieces are re-

Table II. Approximate Machine Settings for Seam Welding Aluminum Alloys

Alloy	Thickness In.	Pressure Lb.	Cycles On	Cycles Off	Spots Per in.	Approx. "On" RMS Amperes
52S½H	.025	600	1	6½	18.0	26000
52S½H	.032	680	1	6½	16.0	29000
52S½H	.040	760	1	6½	14.3	32000
52S½H	.051	855	1½	6	12.6	36000
52S½H	.064	960	1½	6	11.3	37500
52S½H	.072	1015	1½	6	10.6	39000
52S½H	.081	1080	2	11½	10.0	40000
52S½H	.102	1210	2	11½	9.0	42500

For 52S¼H—Reduce pressure 10%
For 52SO —Reduce pressure 25%
For 3S½H —Reduce pressure 25%

Note: A V-shaped wheel contour with a 166-deg. included angle should be used.

moved from the dies. The freezing takes less than a second.

The distance that the two pieces move together after their ends become fluid is predetermined. To prevent them from moving too far, an adjustable contact device opens the main contactor and thus shuts off the current.

The success of "push" welding depends upon an excellent mechanical fit between the two parts to be welded together. The dies also must be so designed that they will give uniform current distribution. The method is most applicable when the sections to be butt welded are simple in contour, such as round or rectangular bars.

In butt welding complicated extruded shapes, "push" welding is not used, because of the difficulty of designing dies which will provide uniform current distribution. For such cases the "flash" welding method is used.

In flash welding, the parts to be welded are clamped in their dies with a small gap between them. The current is turned on, after which a motor and cam mechanism is started which causes the two pieces to come toward each other horizontally at a slow initial speed. The cam accelerates this movement.

As the two pieces touch, the current causes a continuous burning off, and the heat from this burning softens the metal. At the close of the flashing period the cam provides a quick push-up, fast enough to stop the flashing. At this time the contactor is opened and the weld is completed.

Current distribution is automatically taken care of since most of the heat is generated during the flashing period. The current distribution is affected to only a small extent by the design of the dies. This permits the flash welding of complicated extruded sections, such as window frames.

The adjustments for different types of sections vary so greatly that it is impossible to compile figures for suitable current densities, pounds per square inch, amount of burn-off, and other essential information. Before equipment for butt welding aluminum alloys is obtained, sufficient tests should be made on the particular jobs in question to assure the purchase of a machine having the correct electrical and mechanical specifications.

Removing Iron from Nickel Solution

Q.—How may the iron contents of an acid nickel sulphate solution be precipitated? I know that $NaHCO_3$+H_2O_2+$Fe\ SO_4$ are used but I am ignorant of the proportions used per gal.

A.—A method that has been widely used for purification of nickel was described by F. J. Liscomb in the December 1933 issue of the Monthly Review, published by the American Electroplaters Society. Secretary W. J. R. Kennedy, 90 Maynard St., Springfield, Mass, will inform you how to obtain the Monthly Review.

The Liscomb method is as follows:

1. Warm the solution to 125 to 150 deg. F.
2. Raise pH to 6.3 (Brom Cresol Purple indicator) Ammonia is used for a room temperature solution and nickel carbonate for a Watts Nickel solution to bring the pH up.
3. Dissolve some ferrous sulphate crystals in a small portion of the nickel solution. Use 12 ozs. of ferrous sulphate for each 100 gallons of nickel solution to be treated. Add to the main tank.
4. Allow solution to stand for an hour or two.
5. Finally add 5% hydrogen peroxide, using 33 fluid ounces of peroxide to each 100 gallons of solution. Stir in well.
6. Allow solution to stand overnight. The precipitate will settle to the bottom and will contain all the iron as well as other impurities such as zinc, copper, and any organic colloidal impurities. The precipitate can be removed by filtration or by decantation of the clear solution.

The general idea of the above method is that iron is purposely added to the solution and then is precipitated as ferric hydroxide by bringing up the pH of the solution and adding hydrogen peroxide for the oxidizing. The resulting ferric hydroxide precipitate is of a voluminous gelatinous nature and envelopes many insoluble impurities such as organic materials.—G. B. Hogaboom, Jr.

Silver Solution

Q.—We are sending under separate cover a sample of our silver strike, also a sample of our silver plating solutions to be analyzed. These solutions have been in use about one year, and have been working all O. K.

Now they need building up and we cannot find the formula, or the man that made them up, originally. Do you know of a formula like this?

A.—The analysis of the solutions show:

	Plating solution	*Strike solution*
Silver	2.13	.33 ozs/gal
Free cyanide .	3.06	1.6 ozs/gal

The silver content in the plating solution is suitable for light plating and can be left as is. If desired to increase the silver content, use silver cyanide, which contains 80½% metal. When adding silver cyanide, also add 1/3 oz. of sodium, or ½ oz. of potassium cyanide to dissolve 1 oz. of silver cyanide, approximately.

The cyanide content of the plating solution can be from 3 to 5 ozs. per gallon, using the latter figure if carbon disulphide is being used and bright silver is desired.

Before making any additions to the plating solution of any value, however, consideration should be given to the fact that this solution is contaminated with other metals. If best solution is desired it would therefore pay to make up new solution, using formulas as given on page 24 of the 1937 Platers Guidebook (Metal Industry) and recovering the metal.

The silver strike is low in cyanide. Add 6½ ozs. per gallon of sodium cyanide.—G. B. Hogaboom, Jr.

Iron on Non Metallics

Q.—Finding a solution for the electro-plating of iron in your Platers' Guidebook, we are interested in learning if a thickness of 3/16" can be plated on a non-conductor.

A.—A thickness of 3/16 inch can be deposited from an iron plating solution such as given in the Guidebook.

No specific information is available on the coating of non-conductors with an iron deposit. Suggest you make trials on the materials in question, using the same methods for metallizing the surface as would be used in applying a copper coating. These would include spraying with bronze lacquer, brushing with graphite, or coating with silver nitrate and sulfiding.—G. B. Hogaboom, Jr.

Non-Ferrous Annealing in Controlled Atmospheres

Some recent developments in continuous, controlled atmosphere furnace equipment for bright annealing non-ferrous wire, tubing, strip, etc.

By **W. F. ROSS**
Furnace Engineer, The Electric Furnace Co., Salem, Ohio

THE necessity of producing bright, smoothly finished material of definite physical characteristics has lead to the universal acceptance of controlled atmosphere annealing furnace equipment throughout the non-ferrous industry. This is particularly true in the field manufacturing small gauge copper, brass, bronze and nickel-silver wire and thin strip stock, although there are many applications in which heavier materials, such as tubing, extruded shapes and straight or coiled bar stock are beneficially annealed in controlled atmosphere furnace equipment.

Comparison of material annealed within a controlled atmosphere will show greatly improved condition of surface both as to finished appearance and smoothness over material annealed at the same time and temperature in ordinary furnace equipment with its necessary second step of pickling and cleaning. The production of work to be annealed for further breakdown is accomplished with complete elimination of the scale that is ordinarily a detrimental factor in die maintenance as well as in the finished appearance of stock.

Clean scale free annealing is possible with practically all of the various alloys of copper with tin and zinc. Such materials as the heavy brasses and nickel-silver show a characteristic deposit of metal sweat at the higher annealing temperatures, which is proportionately decreased with the decrease in treating temperature, and which is, in any case, easily removed in a flash pickle with no noticeable etching action.

The fact that work can be retained under heat for longer periods of time than would be possible in furnace equipment in which scaling or oxidizing action could take place on the surface of the metal, allows complete freedom in regulating the physical characteristics of the finished product. Work annealed in special atmosphere furnaces and held within limits of 2 points in hardness is the common rather than the extraordinary practice.

The ability to leave material within the heating chamber for an unlimited time makes possible the use of lower temperatures to produce physical characteristics ordinarily obtained at temperatures from 100 to 350° higher. The increased time within the heating chamber necessitated by an anneal at a relatively lower temperature allows uniformity of anneal throughout not only the cross section of material on the hearth, but also the individual section of each type of material.

The Controlled Atmosphere

The controlled atmosphere is broadly, a combination of inert gases from which those elements detrimental to surface of the material being annealed are either eliminated or held in combination in a harmless form.

Such an atmosphere may be made from dissociated ammonia in which nitrogen plays the part of the inert

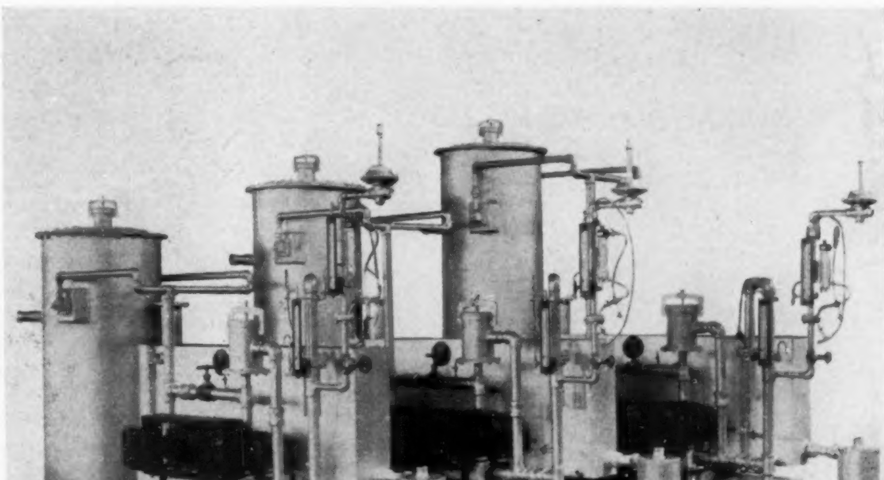


Fig. 1. Three sizes of Elfurno gas generators for producing protective atmospheres used in controlled atmosphere furnaces for bright annealing ferrous and non-ferrous products and for copper brazing, scale-free heat treating, etc.

gas while the hydrogen is beneficially used as a reducing agent. This type of atmosphere is, therefore, known as reducing. Another and more common example of atmosphere is the cleaned and dehydrated gas formed by the products of combustion of natural or manufactured gas with air in which the percentages of CO or CO_2 are controlled within narrow limits to produce either an oxidizing or a reducing atmosphere. As the reaction either way tends toward perfect combustion, a neutral atmosphere is obtained. Generators for producing these special protective atmospheres economically are made in various types and sizes with capacities ranging from a few thousand cubic feet per hour for comparatively small furnaces up to large capacity installations in single units or batteries. Three sizes of gas generators are shown in Fig. 1 (p. 69).

The necessity of producing a controllable atmosphere in regions where combustable gas is not accessible has lead to the recent development of atmospheres produced from the combustion of coal oil, coal, charcoal and other materials of high carbon and hydrogen content.

Sulphur as an element in the composition of the fuel used for producing the atmosphere, requires special treatment, since the non-ferrous metals and annealing temperatures are particularly susceptible to its action. The presence of sulphur in the atmosphere at higher temperatures results in a sulphide skin upon the material which is not easily removed by pickling. This elimination is accomplished in one of several ways, the simplest method of which is the removal of hydrogen sulphide and sulphur dioxide from the products of combustion in scrubbing towers of simple design.

Since water vapor is susceptible to dissociation in the presence of carbon at high temperatures, it is necessary to remove the water formed in the atmosphere by the products of combustion. This removal is further necessitated in order to insure elimination of vapor which might otherwise condense within the cooling hood and drop upon the work thus causing water spots or stains. This is accomplished through suitable traps and by rapidly cooling the atmosphere to a point well below that of condensation before introducing the atmosphere to the annealing equipment.

Controlled Atmosphere Furnace Equipment

Any type of furnace in which a controlled atmosphere may be easily retained is adaptable to the production of clean work. The usual construction of such furnaces embodies a heating chamber contained in a welded steel shell, so fabricated as to be gas tight, and lined with suitable refractory material. Work can be produced clean in batch type furnaces by bringing the material to the required temperature in an atmosphere purged of all air and then cooled under this same atmosphere within the furnace. In continuous furnaces, however, such as the roller hearth type, the roller-rail pusher type, and others in which the work is steadily conveyed through the heating chamber in continuous production, it becomes necessary to add a cooling hood to the discharge end of the furnace, in which the moving work is cooled to a point below which oxidation may occur before discharge. Where a cooling hood is employed atmosphere is maintained in both the heating chamber and the cooling hood.

The necessity of sealing the furnace after purging and during the process of annealing under atmosphere, leads to the use of several ingenious designs for minimizing the loss of the furnace atmosphere at the charging and discharging ends of the equipment.

The electric cast resistance grid type of furnace is especially adaptable to the use of controlled atmosphere. The radiant tube type of furnace which approximates the electric furnace in many ways is also adaptable, since the products of combustion are confined within the radiant tubes themselves and so do not come in contact with the work passing through the furnace. Several furnaces of this type have recently been installed which are producing excellent results on nonferrous products. One of the most recent installations is shown in Fig. 2. This illustrates a continuous roller hearth type furnace for bright annealing copper tubing in coils. The material is conveyed through the furnace on trays which ride on continuously rotating rollers. The radiant tubes used in this furnace are the new gas fired recuperative type radiant tubes developed by The Electric Furnace Company of Salem, Ohio. These tubes incorporate a new principal in radiant tube design. By the recuperative principal the otherwise wasted gases are used to preheat the incoming combustion air before entering the furnace chamber thus requiring less fuel and

Fig. 2. shows the discharge end of a continuous controlled atmosphere furnace bright annealing copper tubing in coils. This furnace is equipped with The Electric Furnace Company's new recuperative type gas fired radiant tubes.

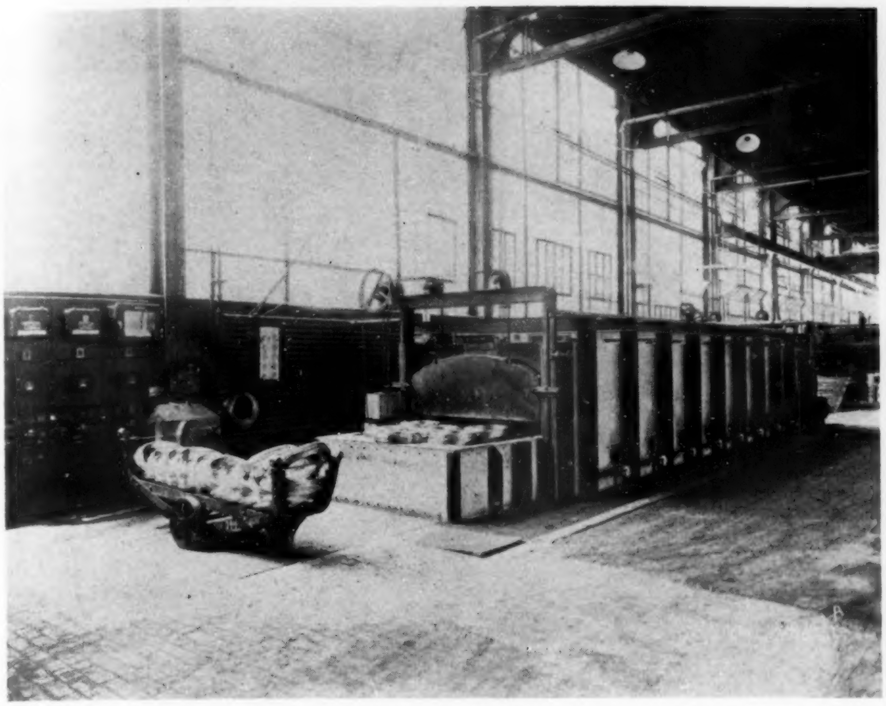


Fig. 3. Continuous gas fired furnace clean annealing brass and bronze wire in coils. The coils are carried through the furnace continuously on a series of heat-resisting alloy chain conveyors spaced to carry both large and small coils. This furnace anneals 5,000 lbs. of wire per hour.

making this tube very economical to operate. By using the waste gases or products of combustion to preheat the incoming air, practically all the heat is utilized and the products of combustion leave the furnace at very low temperature. Another advantage is gained by admitting the necessary combustion air throughout the entire length of the burning chamber thus providing positive mixture of air and gas just where it is needed for perfect combustion. This provides an even temperature over the entire length of the tube and makes it possible to maintain uniform temperature throughout the entire furnace chamber. These tubes are easy to adjust or to install; in fact a tube may be removed and replaced while the furnace is in operation.

Excellent work has also been produced in gas fired furnaces in which the work passes through the heating chamber completely surrounded by a tunnel type muffle of alloy or other non-permeable material. Where clean but not bright work is required a gas fired furnace without the muffle is frequently employed with the products of combustion, from the burners themselves, forming a protective atmosphere. This type of furnace equipment necessitates a careful control of the proportion of air and gas delivered to the burners. Removal of sulphur and water vapor is, of course, not practical in this type of equipment and therefore its use is limited to installations for which sulphur free gas is available. A furnace of this type is shown in Fig. 3, which illustrates a gas fired, continuous furnace for clean annealing brass wire in coils. Both large and small coils are handled in this equipment. The coils are conveyed to the equipment directly on traveling conveyors consisting of heat-resisting alloy chains.

An interesting example of the roller rail type of furnace is found in an installation made in a prominent eastern plant. This equipment consists of a heating chamber and a long water jacketed cooling head with baffle type vestibules at the charge and discharge end, and is used for the bright annealing of various shapes and sizes of bronze and phosphor-bronze wire, coils of which are loaded on alloy trays at the charging end of the equipment. The charging end of this furnace is shown in Fig. 4.

At the proper time interval, which is dependent upon the type of material being annealed, a loaded tray is slowly charged into the charging vestibule adjacent to the charging end of the furnace chamber. As the tray enters the vestibule it comes in continuous contact with baffles within the vestibule, thus minimizing the exfiltration of the atmosphere within the

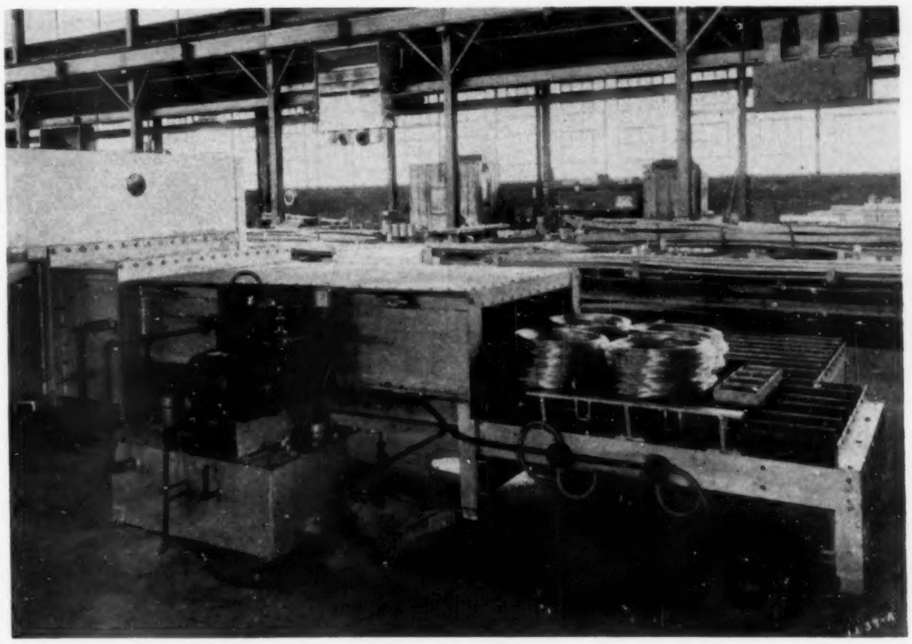


Fig. 4. Shows the charging end of a continuous roller hearth type controlled atmosphere electric furnace for bright annealing various sizes of bronze and copper wire in coils. The wire is loaded on trays and pushed through the furnace and discharged at the other end uniformly annealed, bright and dry.

furnace. Since there are at all times three or more trays in progress through the vestibule, the charging entrance of the furnace chamber is adequately sealed and such atmosphere as does pass from the furnace chamber around the baffles, provides an excellent purge for what air might otherwise pass into the furnace with the work.

The conveying system through the equipment consists of two roller rails extending the length of the heating chamber and the cooling chamber. The trays of material pass in a continuous line over these rails to the discharge end of the equipment where the tray runs out upon a roller top table from which the work is easily removed prior to the return of the tray to the charging end.

This equipment has produced excellent results in the annealing of bronze and phosphor-bronze, and continuously produces soft annealed brass and nickel-silver in a clean scale-free state of remarkably uniform physical composition. The equipment is used over a temperature range of from 700° to 1500°, and is powered at 135 Kw. through two Scott connected transformers. The protective atmosphere is produced in a combustion type generator consisting of a combustion chamber, pumping equipment, cooling coils and the necessary air-gas ratio metering equipment. Prior to introduction to the furnace, the atmosphere is lead successively through a water trap, three scrubbing towers for desulphurization, and a refrigerator for removing any remaining moisture from the atmosphere. An illustration of the complete furnace showing heating chamber, cooling chamber, gas generator, refrigerating unit, scrubbing towers, etc. is shown in Fig. 5.

Fig. 5. This view shows the complete installation from the discharge end of the furnace, including gas generator, refrigerating unit, desulphurizing towers etc. Coiled strip is also handled in this equipment.

A similar installation of furnace equipment for use with various sizes of coils of non-ferrous wire and for extremely fine wire wound on steel spools is producing excellent work in a prominent Detroit plant. An illustration of this furnace is shown in Fig. 6. This equipment is powered at 100 Kw. for use at annealing temperatures of 700° to 1000° F.

Two more special atmosphere installations for the bright annealing of miscellaneous light gauge non-ferrous wires wound on standard size spools have been installed in another plant for the manufacture of fine copper wire in New York state. This equipment differs from that shown in Figures 5 and 6 only in the design of the charging and discharging lock chambers in place of the baffled vestibules.

Spools of wire are packed into an alloy annealing box capable of being hermetically sealed. After packing, this box is purged of air by means of raw gas. It is then loaded upon a tray which is rolled through the exterior door of the charging end lock chamber, and the door sealing this chamber is closed and clamped. At the proper time a door between the dis-

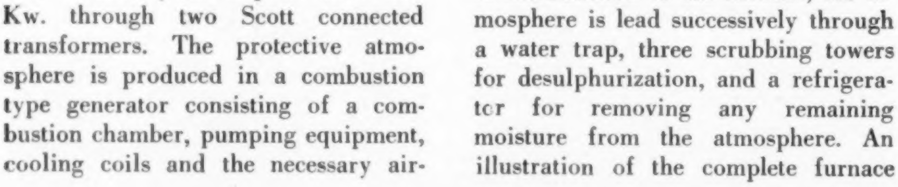


Fig. 6. A 100 Kw., special atmosphere, pusher type electric furnace for bright annealing both heavy and fine copper wire on large reels on spools and in coils.

charge end of the cooling hood and the discharge end lock chamber is opened and a tray of finished material extracted into position in the lock chamber by means of a hydraulically driven extractor mechanism. The door into the cooling hood then closes and the tray of material is removed from the equipment through the external door of the lock chamber. The door between the charging end lock chamber and the furnace chamber proper now opens and a hydraulic pusher at the charging end advances the prepared tray through the door and into the heating chamber, thus advancing each tray within the heating chamber and the cooling hood by one length. The charging pusher is then withdrawn and the furnace door closed leaving the lock chamber empty until a fresh charge is placed within it. The charging end of this furnace is shown in Fig. 7.

Variations in Equipment Designs

Two only of the possible sealing means on continuous furnaces have been mentioned. There are, of course, innumerable other means of minimizing the loss of special atmosphere, any of which are as practical and perhaps as simple as those described.

In all the equipment previously described, the cooling hoods adjacent to the furnace chambers have been of the water jacketed type. Several installations have been made, however, in which cooling is provided by means of banks or sections of water cooled coils through which cold water is continuously forced.

Where floor space is at a premium and it is desirable to cut the overall length of the furnace equipment, successful cooling has been accomplished by means of a centrifugal fan operated recirculation system by which atmosphere is withdrawn from the cooling hood, passed through a heat exchanger and the cooled atmosphere returned to the hood. This method of cooling is particularly adaptable to large equipments.

In all continuous furnaces of the type described in this paper, the element of controlled time interval between charges is particularly useful since the proper combination of furnace temperature and time to produce specific physical characteristics in any one type of material may be exactly duplicated in succeeding runs. The time interval control mechanism is an integral part of the electrical interlock system which makes this type of equipment as fool proof as possible, for safety and automatic operation.

Non-Ferrous Alloys in 1937

By W. D. WILKINSON, JR.
Electro Metallurgical Co., New York

RECENT progress in non-ferrous alloys includes the more extensive use of such alloying elements as chromium, manganese, silicon, calcium, and zirconium. One of the large manufacturers of welding equipment, for example, has added a relatively high silicon-manganese copper welding rod to its line of supplies. This rod will give high-strength welds in Everdur, and in other types of deoxidized copper.

Brasses and bronzes containing manganese, silicon, and other elements are increasingly important in welding rod for joining and rebuilding steel and cast iron—as well as most non-ferrous metals—because a minimum of heating is required to give a high-strength joint and a wear-resistant machinable deposit. The problem of applying this rod to the welding of aluminum bronze has been solved by the development of a special flux.

A new chromium-bearing copper alloy has been introduced for use in high-strength, current carrying parts of rotating machines and for spot or seam welder electrodes. It has satisfactory strength and hardness for this use at moderately elevated temperatures, and has good resistance to flowing, oxidation, and pitting by arcing. It also has high electrical and thermal conductivities, and good machinability.

Another interesting chromium alloy recommended for resistance elements in electric furnaces contains 37.5 per cent chromium and 7.5 per cent aluminum, the balance being iron.

Zirconium additions, made in the form of various zirconium alloys, have been found to increase the hardness of heat-treated copper castings without materially decreasing their conductivity. With heat-treated beryllium copper, zirconium decreases the degree of softening at high temperatures.

Calcium and some of its alloys, such as calcium-silicon and calcium-manganese-silicon, are well known to metallurgists for their deoxidizing and degasifying action. Calcium metal is being used as a scavenger in chromium-nickel alloys, and is also being added to lead for storage battery plates and sheaths.

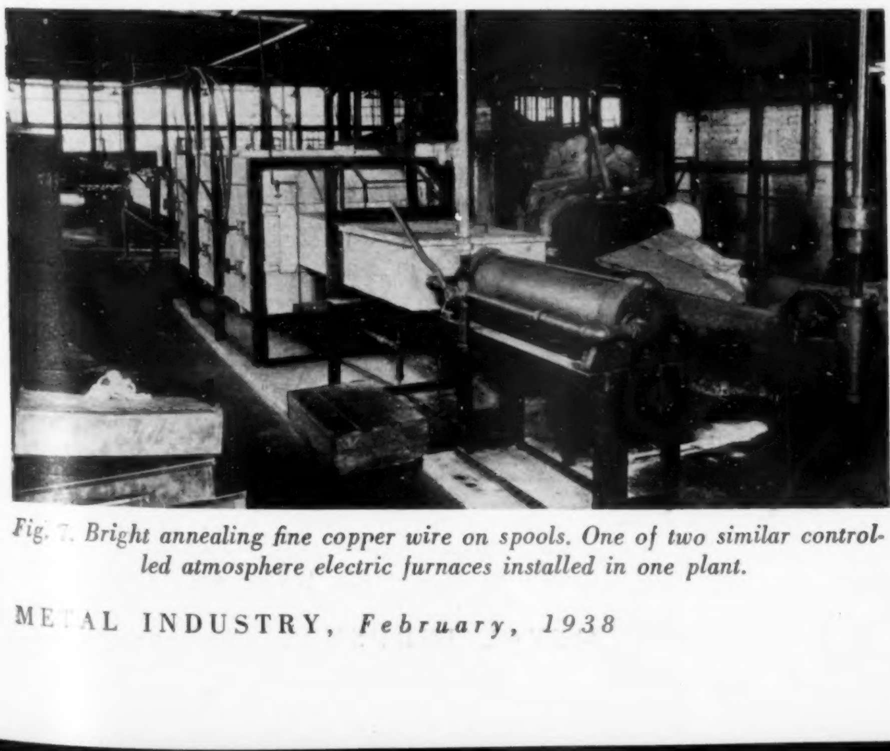


Fig. 7. Bright annealing fine copper wire on spools. One of two similar controlled atmosphere electric furnaces installed in one plant.

Zipper Fasteners Plated Automatically

The features of the mechanical equipment for handling large volumes of zippers continuously. Careful adjustment of automatic parts vital to high quality output.

By **WESLEY F. HALL**

Chief Designing Engineer, Hanson-Van Winkle-Munning Co., Matawan, N. J.

ONE of the most interesting and unique inventions of modern times is the zipper fastener. At the same time, however, the zipper brought with it unusual problems, peculiar to itself, which for some time, kept the manufacturers in hot water. One of the most pressing of these problems was the question of finish. The zippers are so small, they are so difficult to handle individually, their assembly is so much of a problem, that the finishing and plating of the individual pieces would be absolutely out of the question, commercially. The cost would be far out of proportion to the value of the article itself.

The Zipper—a High Production Item

Because the problem involved was one of huge, uniform quantity production the Hanson-Van Winkle-Munning Company, Matawan, N. J., manufacturers of electroplating equipment and supplies, developed a conveyor mechanism to plate zipper fasteners in the strip form in which they are shipped to the manufacturers who include them in their finished textile, leather and other products. The principle of this machine is simple. It is a straight line conveyor which handles the material on tapes, taking it through various tanks, cleaners, plating solutions, rinses, etc., in regular order. The work is so peculiar, however, that special mechanical methods had to be devised in order to provide for consistent uninterrupted production.

Sequence of Operation

The zippers come into the plating department attached or hooked into a cloth tape about 300 ft. long. This tape is led first through a tensioning device providing 4 to 5 lbs. tension, into an electric cleaner tank. The electrical contacts in this cleaner are made by spring rollers. The tape then runs through a set of wringer rolls which squeeze the cleaning solution out of the tape and return the drag-out to

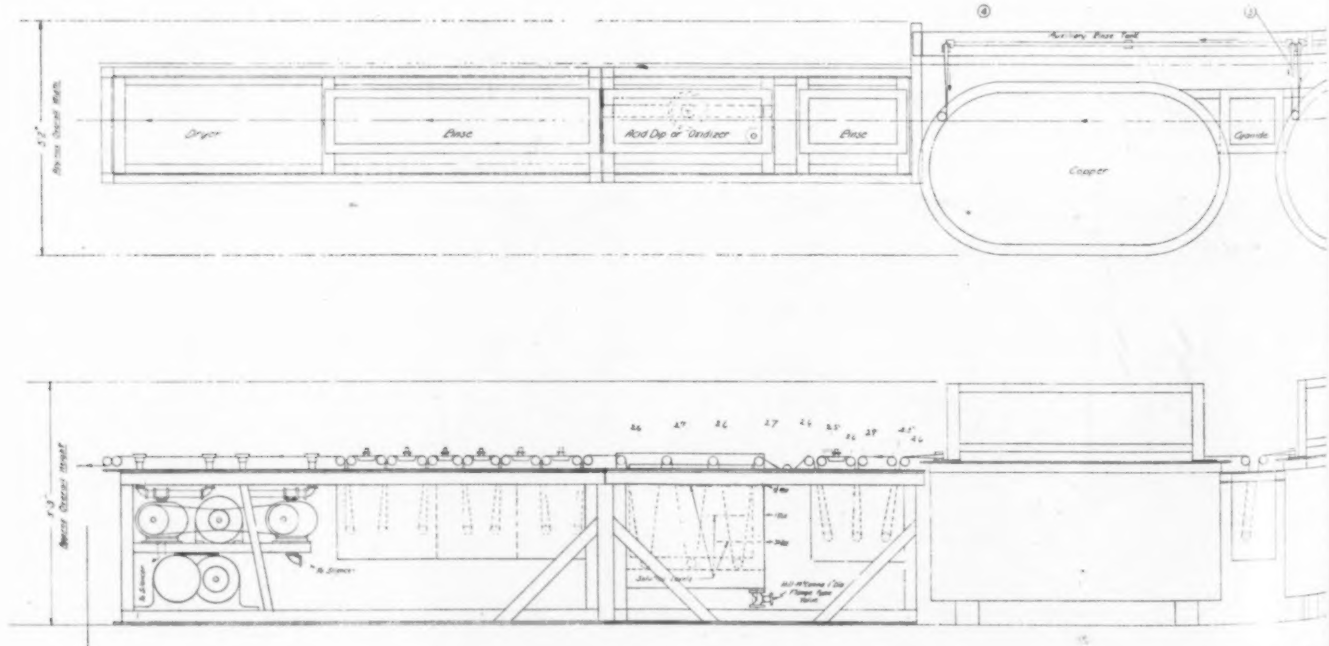


Fig. 1. Plan and elevation of the full

the cleaner tank. The tape is then passed over a series of rollers through a rinsing unit in which live steam is blown through the cloth around the zippers. This rinsing unit is a combination of two live steam pans and three dips; one dip before the first steam pan; then the steam pan; then another dip; then the next steam pan and then the last dip to remove the last traces of cleaning solution. The care with which this operation must be performed is shown by the fact that the tape must show no reaction to litmus after the second dip and before the second steam pan. This second steam bath and the third rinsing are performed simply to make assurance doubly sure.

The tape then passes into an acid dip tank and then to another rinsing unit like the one described above. It then goes into a cyanide dip tank (for brass plate) or a nickel solution dip (for nickel plate), depending upon the finish required for the zipper.

In the plating solution the tape is sent through on a series of rolls, first spiraling down into the solution, then going flat across the bottom of the tank and then spiraling upward again through the solution. By the time the tape with its load of zippers has emerged from this solution the zippers are thoroughly covered with the plate of the metal desired.

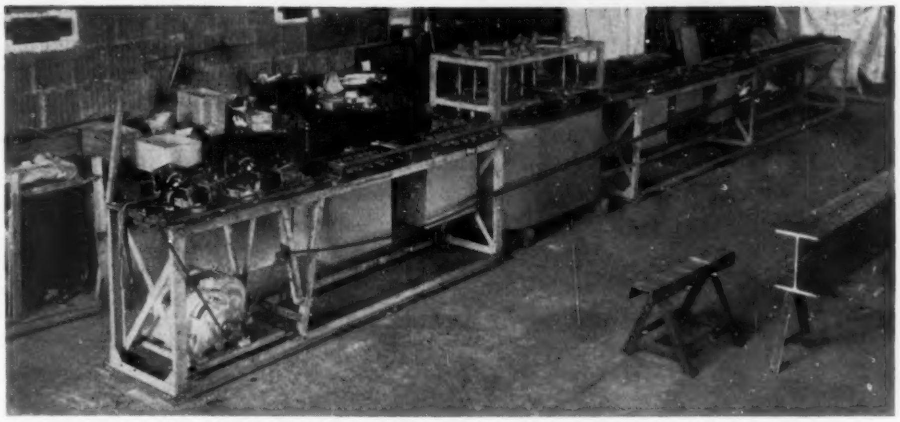


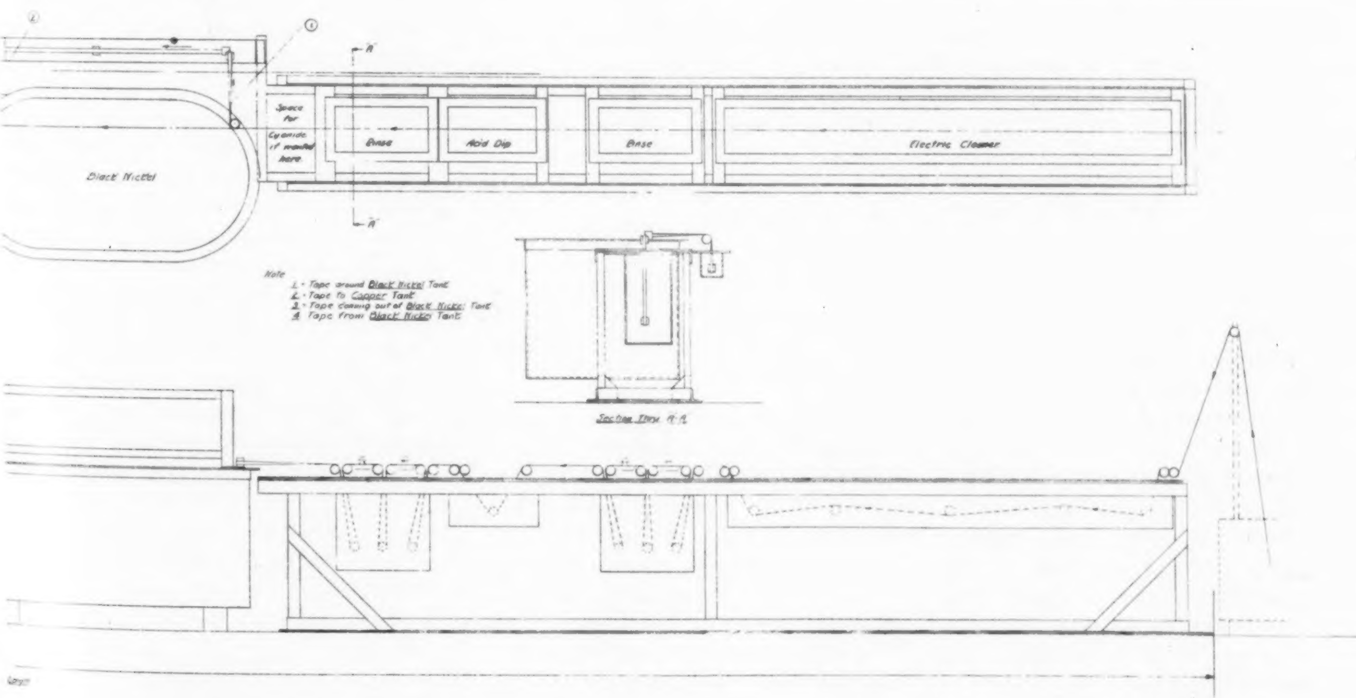
Fig. 2. Zipper plating machine, assembled, but before installing the moisture removers in tail end (left foreground of illustration)

The plating operation is followed immediately by a long rinsing unit consisting of seven dips and six live steam baths, similar in principle to the unit used after the cleaning solution. Obviously the take must come out absolutely free of solution. The dragout is returned to the solution tank.

The tape then passes over an exhauster and dryer to remove the last traces of moisture. As it is under constant tension it comes out smooth and flat. The dry tape is then coiled or folded, or first lacquered, colored, tinted, etc., to provide the final finish required, and then coiled or folded for packing.

Mechanical Features

Some of the mechanical features of this machine are most noteworthy. In the first place the electrical contacts for cleaning and plating consist of spring rollers which are constantly in contact with the line of zippers. Special types of contact are required for different types of zippers depending upon the material of which they are made; die cast zinc base alloy, sheet metal stampings, etc.



aut... tic machine for electroplating zippers

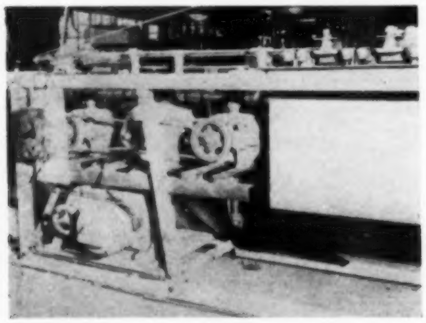


Fig. 3. Moisture removing section of zipper plating machine, placed in tail-end (left foreground of Fig. 2)

All rolls carrying the tape are expandable and contractable to take up slack. Take-up arrangements are utilized at several points acting entirely automatically throughout the entire process so that the tape will not buckle, double on itself, twist, or become involved in any difficulty, in any part of the machine. Approximately 200 ft. of the tape are submerged in the tank at all times in one or another of the various solutions (cleaning, plating, rinsing, etc.)

The effective operation of this machine, simple as it is in principle, depends upon careful adjustment of a number of automatic parts, which called for careful design and much experimental work to eliminate the numerous "bugs" which always appear in every new machine. It is now commercially practical and operating successfully in a number of plants.

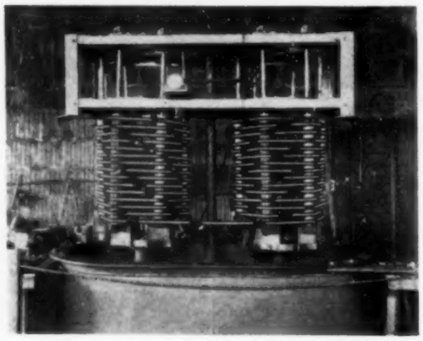


Fig. 4. Spiral plating rack of zipper plating machine, loaded, before lowering into tank.

Plating Copper on Aluminum

An Extended Abstract*

By **WALTER R. MEYER**

Electrochemist, General Electric Co., Bridgeport, Conn.

NUMEROUS methods have been developed for treating aluminum surfaces previous to the electrodeposition of metals. These treatments have included the cleaning of the metal, the removal of existent oxide layers, the creation of a rough surface for anchorage of the deposits and in some cases, the deposition of an intermediate metallic layer such as zinc or iron. In contrast to this procedure, methods have been developed which embody an electrochemical oxidation to artificially strengthen the oxide film. The oxide film is loosened in the alkaline solution thus creating a skeleton type of foundation upon which the metal being deposited firmly anchors itself. The method reported by the above authors consists of a chemical oxidation followed by deposition of copper from an acid solution. The sequence is as follows:

(1) Clean in cold 10% caustic soda solution (10 minutes) and neutralize in 2% hydrochloric solution.

(2) Immerse 15 minutes in a hot mixture of sodium carbonate and sodium monochromate or sodium vanadate followed by rinsing in cold water.

(3) Copper plate in the following:

Copper sulfate	150 g/l
Sulfuric acid (65%)	60 g/l
Gelatine	.01-.1 g/l
Current density	10-11 amps./ft.^{2}
Time	60-90 minutes
Temperature	20-25°C.

In the acid electrolyte, the protective coating is removed laterally from the pores. Simultaneously with the removal of the protective coating from the base metal, a deposition of copper occurs, thus preventing the formation of a new oxide layer. The deposits therefore showed extraordinarily low electrical contact resistance with the aluminum. A slight porosity of the oxidized protective coating is required for a uniform deposition of copper. This was shown to be true by the formation of rough deposits of copper on aluminum when the oxidized layer was treated with boiling water to close the pores. The adhesion of the copper to the base metal was shown to be excellent by the absence of exfoliation under the Erichsen cup test, and upon hammering or bending. Samples could also be heated to 400°C. and cooled in the air without blistering. The alloys which could be coppered most satisfactorily were Pantal, Mangal, and Silumin, whereas the adhesion upon Duralumin was not as satisfactory because Duralumin does not form a satisfactory layer in the oxidizing solution. The electrical contact resistances were measured by forming a column of copper plated aluminum discs and passing a current through this column. The contact resistance was noticeably higher if the copper solution contained gelatine and hence, if the copper plating is to be done for low contact resistance, no gelatine should be used in the copper plating solution. The porosity of the copper layer is strongly dependent upon the nature of the base metal; namely, upon its chemical composition, heat treatment and method of rolling. Aluminum alloys containing silicon are satisfactory if the silicon is in solid solution or in a finely dispersed state, but if the silicon has coagulated, quite unfavorable deposits are produced. It is recommended therefore that if good protection against corrosive atmosphere is desired, a coating of colorless lacquer should be applied over the copper coating. No mention was made of the suitability of the copper coating for subsequent deposition of other coatings such as nickel but if the copper coating is properly applied it should be a good ground for deposition.

The above mentioned process is quite unique in that an acid copper solution is used which ordinarily would be quite unsuitable for deposition upon aluminum. The coating of oxide however, prevents the reaction between the aluminum and the copper solution and an adherent coating of copper can be deposited as soon as the oxide has been removed, thus preventing the formation of a spongy undercoating. A skeleton type of structure results due to the progressive lateral building of the copper deposits from the pores in the oxide layer.

*Translated and abstracted from Die Galvanische Abscheidung von Kupfer auf Aluminium nach Vorausgegangener Chemischer Oxydationen, Von Werner Helling und Heinrich Neunzig. *Aluminium,* May, 1937.

A Study of the Rochelle Salt-Copper Plating Bath

Part IV. The Effect of Bath Composition and pH on the Current Efficiencies.*

By Dr. A. KENNETH GRAHAM[1] and HAROLD J. READ[2]

It HAS previously been shown that a copper bath containing carbonate will normally have a pH of 10.3 to 13.0, depending on the amount of sodium hydroxide present. PH values of 10.7 to 12.8 are frequently attained in commercial baths although pH values from 12.0 to 12.8 have been recommended as being more practical. In Part IV of this paper the effect of pH and of the bath composition on the current efficiencies has been studied as the pH was varied from 10.7 to 12.8.

The anode efficiencies were determined at 131°F using a current density of 16.8 a./s.f. in all cases but two. Baths 10 and 11 required a lower anode current density (9.6 a./s.f.) in order to avoid the excessive polarization of the anode (at relatively low current values) which occurs in these baths containing no carbonate. The cathode efficiencies were determined at a cathode current density of 30 a./s.f. for all bath compositions and pH values. In a few cases cathode efficiencies at current densities of 20 and 50 a./s.f. were also obtained. The current efficiencies were all determined by running the test bath in series with a copper coulometer in the usual manner. The values thus obtained are recorded in Table VI where the bath numbers refer to the bath composition in Table II.

In Figures 11 to 15 the current efficiencies recorded in Table VI are plotted against the initial pH of the bath. The solid lines represent anode efficiencies and the dashed lines represent cathode efficiencies. Each line is numbered corresponding to the bath composition in Table VI. In most cases the lines are determined by only two points at pH values of 10.7 and 12.8. Under these conditions if the lines are horizontal it is inferred that the efficiency is constant between these pH limits. If the line slopes upward or downward, it indicates the direction and extent of the efficiency change within the pH limits mentioned. With baths Nos. 1, 3 and 10, efficiencies at three or more pH values were determined.

TABLE II. Bath Compositions Studied

Bath No.	CuCn oz./gal.	Free NaCN oz./gal.	Rochelle salt oz./gal.	Soda ash oz./gal.	Variable
1	3.5	0.75	4	2	Reference bath
2	3.5	2.0	4	2	Higher free cyanide
3	3.5	0.75	4	9	Higher carbonate
4	4.0	1.6	..	2	No tartrate
5	5.5	0.75	4	2	Higher metal
6	7.0	0.75	4	2	Still higher metal
7	3.5	0.75	8	2	Higher tartrate
8	3.5	0.75	8	9	High tartrate & carbonate
9	7.0	0.75	8	2	High metal & tartrate
10	3.5	0.75	4	0	No carbonate
11	3.5	0.75	8	0	High tartrate, no carbonate

Table VI. Effect of Bath Composition and pH on the Current Efficiencies of the Rochelle Salt—Copper Baths[1]

Bath No.	Bath Variable	Anode pH[2] B	Anode pH[2] A	Anode C.D. a./s.f.	Anode Efficiency %	Cathode pH[2] B	Cathode pH[2] A	Cathode C.D. a./s.f.	Cathode Efficiency %
1		13.3	13.3	16.8	1.7	12.8	12.8	20	52.3
1		12.8	12.7	16.8	44.7	12.8	12.8	30	47.2
1	Bath	12.2	10.5	16.8	67.3	12.8	12.8	50	36.9
1	Reference	11.7	10.5	16.8	69.4	10.7	10.8	20	48.6
1		10.7	10.8	16.8	72.0	10.7	10.8	30	48.7
						10.7	10.8	50	42.8
2	Free	12.8	12.8	16.8	90.8	12.8	12.8	30	27.5
	Cyanide	10.7	10.7	16.8	85.2	10.6	12.1	30	26.8
3	Carbonate	12.8	12.8	16.8	76.8	12.8	12.8	30	35.9
	9 oz./gal.	11.8	11.6	16.8	64.7	10.6	10.6	30	39.0
		10.6	10.6	16.8	62.8				
5	CuCN	12.8	12.8	16.8	60.0	12.8	12.8	30	64.3
	5.5 oz./gal.	10.7	10.7	16.8	82.0	10.7	10.7	30	63.2
6	CuCN	12.8	12.7	16.8	98.6	12.7	12.7	30	68.1
	7 oz./gal.	10.7	10.4	16.8	97.5	10.7	10.7	30	70.0
7	Tartrate	12.8	12.8	16.8	71.2	12.8	12.8	30	47.2
	8 oz./gal.	10.7	10.5	16.8	64.3	10.7	11.7	30	44.7
8	High tartrate	12.8	12.8	16.8	67.7	12.8	12.8	30	43.1
	& carbonate	10.6	10.5	16.8	65.6	10.7	10.6	30	44.7
9	High copper	12.8	12.8	16.8	85.7	12.8	12.8	30	73.3
	& tartrate	10.8	10.7	16.8	83.8	10.7	10.8	30	70.4
10	No car-	12.8	12.8	9.6	90.8	12.8	12.8	30	58.6
	bonate	11.4	10.0	9.6	57.8	11.4	12.2	30	48.0
		10.6	10.0	9.6	57.2	10.7	12.0	30	49.7
11	High tartrate	12.8	12.8	9.6	77.7	12.8	12.8	30	57.6
	No carbonate	11.4	10.0	9.6	55.6	11.6	12.2	30	49.3

Note 1: Bath compositions in Table II.

Note 2: pH values B—before efficiency determination, A—after efficiency determination.

*Parts 1, 2 and 3 were published in our issues for November 1937, December 1937, and January 1938.

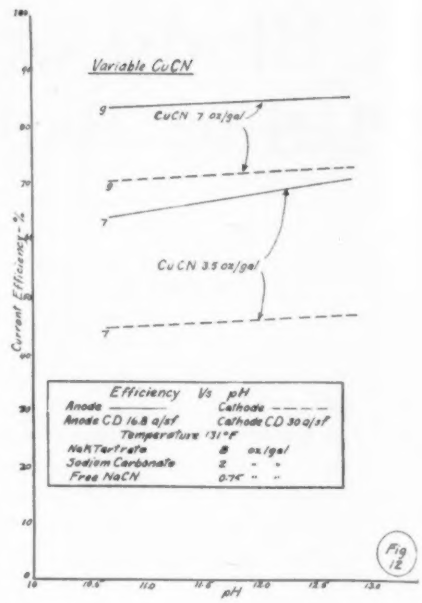
[1]Consultant, A. Kenneth Graham and Associates, Jenkintown, Pa.

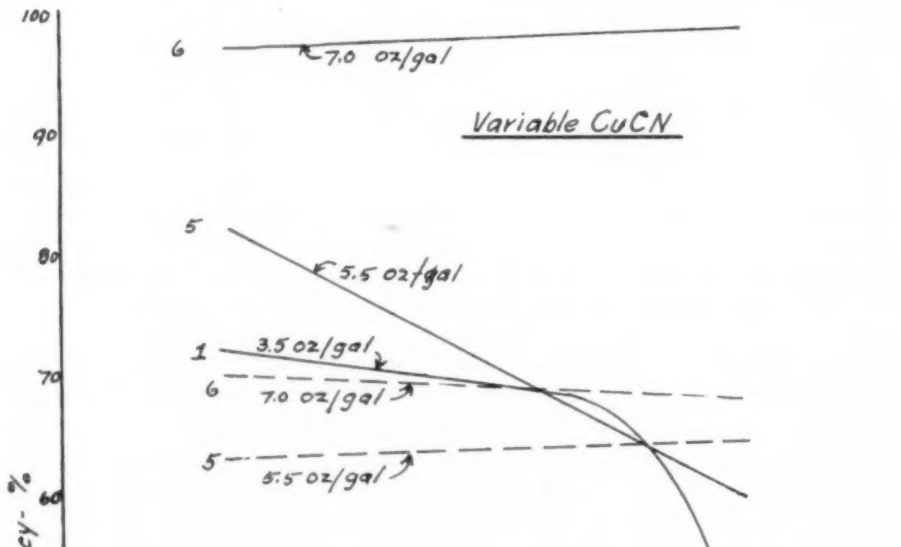
[2]Present address: Dept. of Chemistry and Chemical Engineering, John Harrison Laboratory, University of Pennsylvania, Phila., Pa.

Effect of CuCN Concentration

In Figure 11 the current efficiencies for baths Nos. 1, 5 and 6, corresponding to 3.5, 5.5 and 7.0 oz./gal. of copper cyanide respectively, are compared within the pH range of 10.7 to 12.8. It should be noted that the anode and cathode efficiencies are both increased by raising the copper cyanide concentration. Furthermore, the anode efficiency at 16.8 a./s.f. is always higher than the cathode efficiency at 30 a./s.f. and cathode efficiencies are practically constant between the pH limits studied.

The anode efficiency for baths Nos. 1 and 5 decreases at the higher pH values and at a pH of 13.3 the anode efficiency in bath No. 1 was less than 2%. It should be remembered that at this pH the copper anode did not excessively polarize at current densities below 76 a./s.f. The apparent insolubility of the copper anode under these conditions is the logical explanation of this behavior, thus the copper behaves much like the iron electrodes described in Part III of this paper. This case differs from one in which excessive polarization was prevented by the solvent action of the bath in removing insulating layers from the anode, such as was observed in baths with high carbonate content. The anode efficiency for the 7 oz./gal. copper cyanide bath (No. 6) is practically constant between pH 10.7 and 12.8. It might be expected to decrease at a higher pH. Furthermore, at temperatures higher than 131°F both anode and cathode efficiencies would probably be somewhat higher for the same current densities. To insure fairly constant anode efficiency, therefore, the pH and temperature should be closely controlled. Particularly is this true for bath compositions similar to Nos. 1 and 5 which contain the lower concentrations of copper cyanide and are preferred to the 7 oz./gal. bath (No. 6).

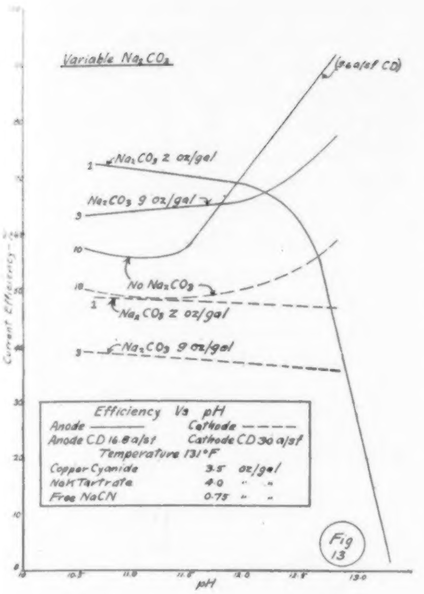




Effect of Rochelle Salt Concentration

In Figure 12 the current efficiencies for baths Nos. 7 and 9, containing 3.5 and 7 oz./gal. of copper cyanide respectively, are compared within the pH range of 10.7 to 12.8. These baths also contain 8 oz./gal. of Rochelle salt instead of 4 oz./gal. as mentioned in Figure 11 and Table VI for baths Nos. 1, 5 and 6. In general, the effect of the higher copper cyanide is the same in each case. The effect of the higher Rochelle salt, however, is pronounced in the case of bath No. 7. The anode efficiency is noticeably higher at the higher pH values (No. 7, Fig. 12) than with bath No. 1 (Fig. 11), containing only 4 oz./gal. of Rochelle salt. This is clearly shown in Table VI where the anode efficiency at a pH of 12.8 for baths Nos. 1 and 7 is 44.7 and 71.2 per cent respectively. It is believed that the higher Rochelle salt would permit operating at still higher pH values with reasonably high efficiency. This really means that with 8 oz./gal. of Rochelle salt the anode efficiency is less influenced by pH changes than with the lower concentration (4 oz./gal.).

The anode efficiency in the 7 oz./gal. copper cyanide baths (Nos. 6 and 9, Figures 11 and 12) is not affected by a pH variation from 10.7 to 12.8. In both solutions the efficiency is fairly constant, but bath No. 9, containing the larger amount of Rochelle salt (8



oz./gal.) has a lower anode efficiency than bath No. 6, containing 4 oz./gal. of Rochelle salt. It appears, therefore, that the effect of the concentration of Rochelle salt varies somewhat with the concentration of the copper cyanide and that 8 oz./gal. of Rochelle salt is the better concentration.

Effect of Sodium Carbonate Concentration

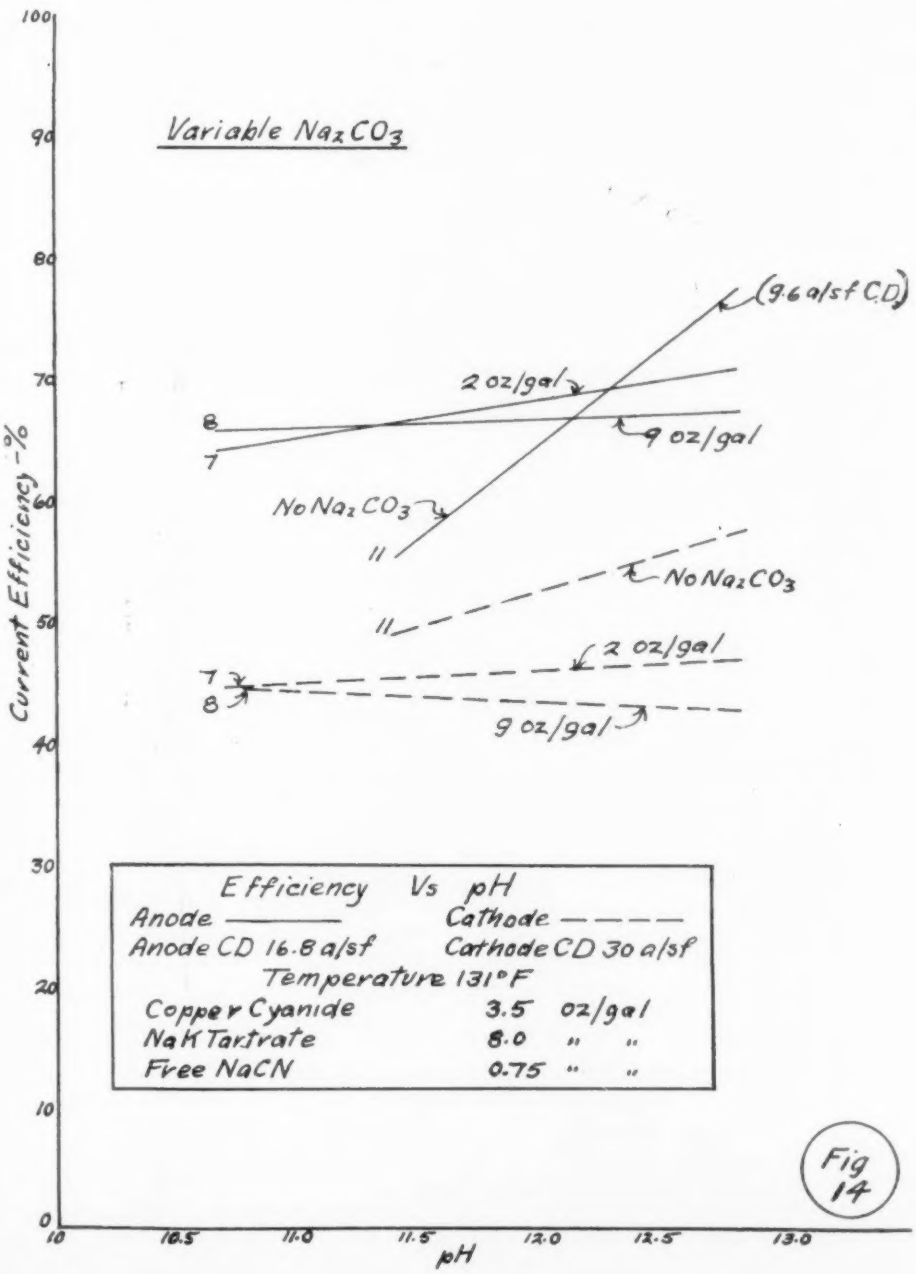
In Figure 13, the current efficiencies of baths Nos. 1, 3 and 10, containing 0, 2 and 9 oz./gal. of sodium carbonate (soda ash) respectively, are compared within the pH range of 10.7 to 12.8. These baths all contain 3.5 oz./gal. of copper cyanide and 4.0 oz./gal. of Rochelle salt. In the absense of carbonate the current efficiencies are more sensitive to changes in pH. In the presence of 2 or 9 oz./gal. of carbonate the cathode efficiencies are practically unaffected by changes in pH (See Curves Nos. 1 and 3). The anode efficiencies for these baths, however, indicate that in the presence of a higher concentration of carbonate (9 oz./gal.) the efficiency increases at the higher pH values while with only 2 oz./gal. of carbonate the efficiency decreased rapidly at the higher pH values. These results are somewhat confusing and no explanation can be offered. It should be noted, however, that at pH values between 10.7 and 12.5 the anode efficiency is not appreciably affected by pH changes as long as carbonates are present. Within this same pH range the anode and cathode efficiencies are somewhat lower for bath No. 3 containing 9 oz./gal. of carbonate than for bath No. 1.

Figure 14 offers the same comparison as to the effect of sodium carbonate except that the Rochelle salt concentration is 8 oz./gal. instead of 4 oz./gal. With the higher Rochelle salt concentration the anode and cathode efficiencies for baths Nos. 7 and 8 containing 2 and 9 oz./gal. of carbonate are practically unaffected by changes in carbonate concentration. In other words, the higher concentration of Rochelle salt makes these baths independent of the amount of carbonate in so far as the efficiencies are concerned and overcomes the apparent variation due to carbonates noted in baths Nos. 1 and 3 (Figure 13).

In the absence of carbonates the anode and cathode efficiencies are quite sensitive to changes in pH. The efficiencies for bath No. 11 (Figure 14) containing no carbonate, increase rapidly as the pH is raised from 11.4 to 12.8. It is recommended, therefore, that 2 oz./gal. of carbonate be added to a Rochelle salt bath. It is also evident that 8 oz./gal. of Rochelle salt would be preferable to 4 oz./gal. because of the manner in which the larger amount of Rochelle salt modifies the effect of carbonates as the concentration increases in the bath during operation.

Effect of Free Cyanide Concentration

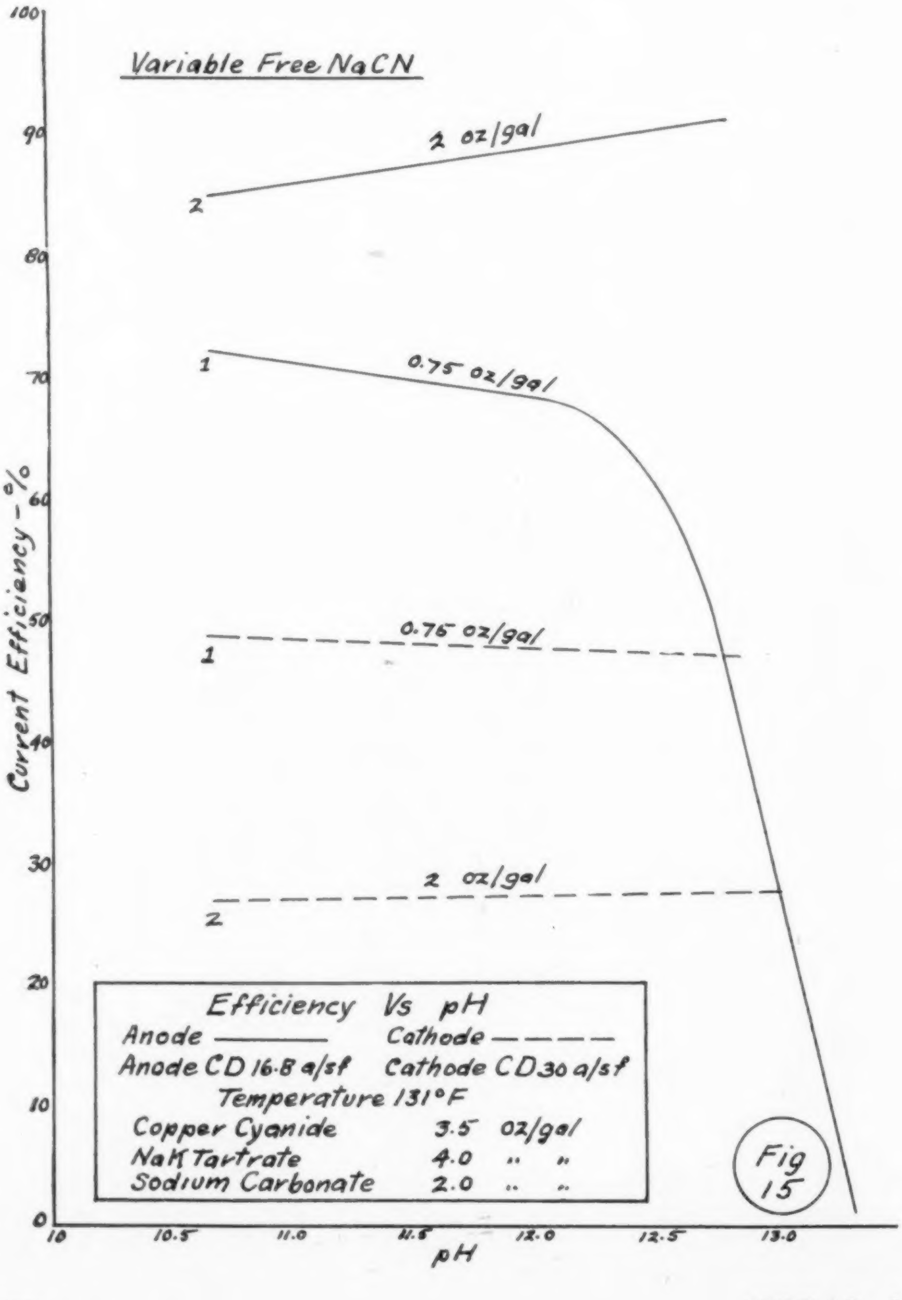
In Figure 15 (p. 80) shows the effect of increasing the free cyanide concentration on the current efficiencies as the pH is varied from 10.7 to 12.8. Bath No. 1 contains 0.75 oz./gal. of free sodium cyanide, the amount used throughout this investigation, and bath No. 2 contains 2 oz./gal. of free cyanide. The effect of increasing the



free cyanide is the same in the Rochelle salt bath as in the conventional copper cyanide bath. As the free cyanide is increased the anode efficiency is raised and the cathode efficiency is lowered. The higher free cyanide (bath No. 2) makes the anode efficiency less sensitive to pH changes, but carbonates and higher concentrations of Rochelle salts offer the same improvement without adversely affecting the efficiencies. Furthermore, the higher the free cyanide the more rapidly will the bath composition change due to widely different anode and cathode efficiencies, to decomposition at higher temperatures and to the accumulation of carbonates resulting from its decomposition. A free cyanide concentration between 0.7 and 0.9 oz./gal. will prove satisfactory although lower values are frequently used. Regardless of the value chosen, it must be controlled within narrow limits by regular analysis if consistent results are to be obtained.

pH Variations

In Table VI the pH of the baths before and after the anode and cathode efficiency determinations is recorded. As would be expected from the buffer curve (Figure 1, Part II) all baths with an initial pH of 12.8 remained substantially constant during the runs. All baths with an initial pH of about 11.7 varied appreciably during the runs because of the poor buffering within this range. The baths with an initial pH of 10.7 decreased slightly during the anode efficiency determinations when carbonates were present, but baths Nos. 10 and 11 fell to a pH of 10.0 in the absence of the buffering effect of carbonates. During the cathode efficiency determinations where the anode area was usually much larger than the cathode area the pH frequency rose during the run, if the initial values were not in a well buffered region such as 12.8 and possibly 10.7 in the presence of carbonates. Baths Nos. 10 and 11 containing no carbonate are again the exceptions. Plant experience also confirms these results and for this reason most baths are operated in a pH range of from 12.0 to 12.8 affording greater ease of control within about four tenths of a pH unit.



Summary

The following conclusions have been drawn regarding the effect of bath constituents on the current efficiencies within the pH range from 10.7 to 12.8 and at a temperature of 131°F.

1. As long as carbonates are present in the bath the cathode efficiency is practically independent of pH.
2. The anode efficiency varies with pH depending upon the bath compositions.
3. A Rochelle salt concentration of 8 oz./gal. is superior to 4 oz./gal. in that the anode efficiency is less influenced by pH and by variation in the carbonate concentration.
4. At least 2 oz./gal. of carbonate should be present in the bath. Higher concentrations need not be added as carbonates tend to build up during operation.
5. The free sodium cyanide concentration should be kept low and should be controlled within a few tenths of an ounce per gallon for consistent results. Concentrations between 0.25 and 0.9 oz./gal. have been used successfully, although a value of 0.75 oz./gal may be recommended.
6. A copper cyanide concentration of 3.5 to 5.5 oz./gal. is preferred to higher values. The higher the copper cyanide concentration the better the current efficiencies, but the character of deposit is not as good at higher concentrations.
7. The optimum pH for practical control appears to be between 12.0 and 12.8. Actually the pH control should be within about four tenths of a pH unit.

In Part V, which is to follow, the effect of bath composition, temperature, agitation, pH and current density on the character of deposit will be discussed.

The Market for Metals

A review of 1937 and a pre-view of 1938.* The rise in prices was caused by speculation; the fall by decreased industrial demand. Higher prices in 1938 are indicated.

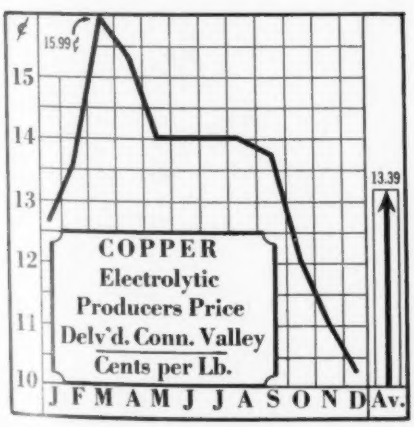
Questionnaire IV. Sent to Metal Producers, Metal Traders and Market Experts to Judge Metal Markets

Question 1. To which of the following causes do you attribute the rise in metal prices during the first part of the year? (1) War demands and re-armament (2) Speculative buying (3) Increased industrial demand (4) Curtailment of production.

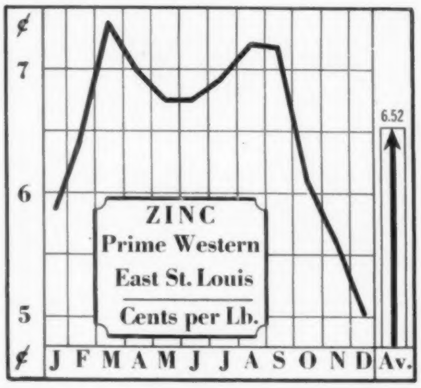
Over 50% of those who replied stated that speculative buying, especially in Europe, had been the primary cause of the rise in metal prices during the first part of the year. A secondary cause was the war and re-armament demand. Increased industrial demand, while it had some effect, was a minor factor in the steep ascent of the prices of most industrial metals. An additional factor noted by one of the replies was "over-buying," which was only semi-speculative in character since it anticipated (in error, of course) the continued rise in price of metals and the continued demand for finished products.

Conclusion: The primary factor in the rise in metal prices was *Speculation.*

Question 2. To what cause do you attribute the fall in metal prices during the past few months?



About 45% of the replies pointed to decreased industrial demand as the major factor. Other factors were, of course, speculative selling and the falling off of war and re-armament



demand. An interesting addition to the above causes was semi-speculative "under-buying," (a reversal of the "over-buying" policy) which consisted of buying for less than current needs, thus "outguessing the market."

To be sure, some of the causes listed above are intertwined and consequently difficult to segregate accurately. It is somewhat puzzling to find that the *rise* was caused by *speculative buying* primarily, but that the *fall* was caused by *decreased industrial demand,* and not by *speculative selling,* as one would theoretically expect. Nevertheless, the weight of opinion is undoubtedly correct. A large part of the speculative purchases abroad have probably been absorbed by the heavy demand for armaments and by industry, which is still active in Europe, and has not generally felt the current decline in the United States. Stocks of metals in Europe have risen very little compared to stocks in the United States.

Question 3. In your opinion what are the prospects for the prices of metals in 1938?

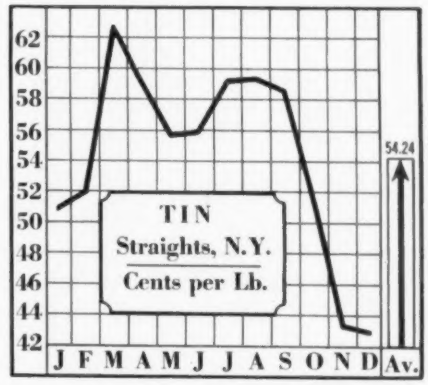
Here was a more difficult question. It involved an estimate of the future—prediction—rather than a statement of fact concerning the past. Nevertheless, two-thirds of the replies to this question subscribed to the belief that *metal prices in* 1938 *would be higher than in* 1937.

The reasons for this belief were, in order of importance and the weight of opinion:

1. Increased industrial demand.
2. Increased war and re-armament demand.
3. Curtailment of metal production.

An interesting and highly indicative opinion was given by *Sigmund Cohn,* platinum refiner of New York.

Charles Engelhard, President of *Baker & Company, Inc.,* Newark, N. J., platinum refiners, looks con-



"Consumers' stocks on hand are very low and demands for replacement of inventories are likely to be heavy. A rise in price would be natural under these conditions after a prolonged decline."

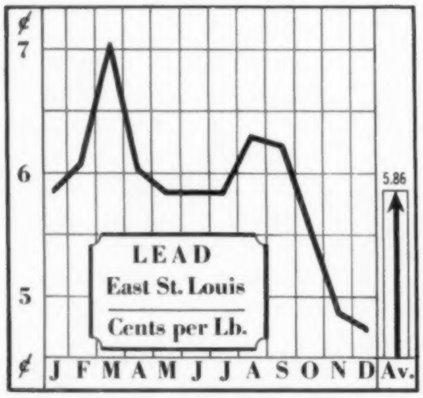
fidently toward the new year, expecting in the near future a readjustment of demand on a more or less normal basis. He considers the present prices of the platinum metals exceptionally attractive. His company is not anxious to decrease its stock on hand at present prices.

Silver is in a category different from all other metals as the price is determined largely by the United States Government policies. The cause of its

*A part of the Survey published in our January issue, but omitted at that time for lack of space.

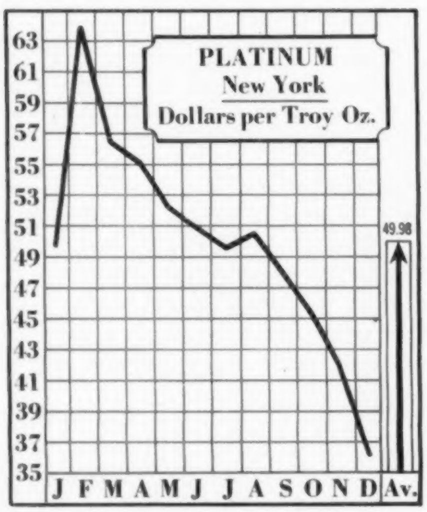
recent fall was uncertainty about the action of the Government. Since the price for the coming year has been set (64.66c per oz. Troy) the chances are that the market should remain stable, unless the Government reverses its open market policy.

Concerning the great tonnage base metals, copper, lead and zinc, the

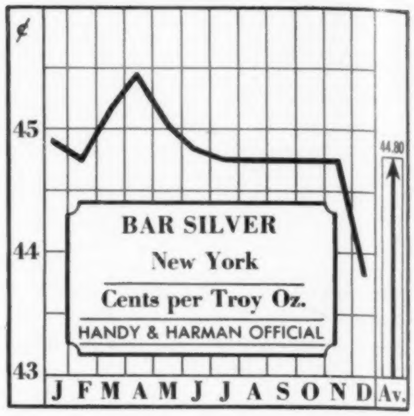


weight of opinion leans toward a good market in 1938, with prices higher than at present. One executive believes that differences between the Government and the utilities will be settled, resulting in more construction and a call for metals in a heavy volume from an industry so far conspicuous by its absence from the market.

The indications are that the price of tin, which, although not an American produced metal, is one of the most important elements in our industry, since we use almost one-half of the entire world's production, will remain about the same as at present. It is not expected that general industrial demand will be sufficient to raise its price to any extent. At the same time, the international tin producers' organization should keep production allotments within bounds to hold the market on an even keel.



Conclusion: A general "preview" of the metal market for 1938, indicates the probability of higher prices for most metals, but not sufficiently higher to make them an attractive speculation. The safe course for business is to buy its metals for reasonable current needs.



Buffing Without Leaving Marks

By H. MOORE

Brass Polisher, Leeds, England

FINGER marks on finished buffed work may be only a minor annoyance but they can easily become major ones if the marks are greasy and the pieces numerous. Polishers cannot do their work very well with clean hands and the greasy nature of some polishing compounds makes the fingers sticky. Any marks left on the work after finishing on the wheel must, of course, be removed afterwards by hand and this becomes more difficult the longer the marks are allowed to remain. If they are removed immediately, while the work is warm, they come out readily but if the piece is allowed to cool it is harder to get them out.

Buffing Tubes

Let us take a few simple examples of work. For example, suppose that a batch of two inch brass tubes six inches long are to be buffed without leaving a mark. Some polishers will put their fingers in the ends of the tubes with the disadvantage already noted. Putting a piece of wood in the tubes is not much good because if the wood is a loose fit the tube will revolve; if it is tight it has to be driven in and out and this is hard to do without making a mark. My own method is to use two sticks about half as wide as the diameter of the tube and about six inches longer. I stick these inside the tube leaving about three inches at each end protruding, then I cross them and in the vees thus formed I grasp one at each end and press my fingers inwards. This spreads the sticks apart to grip the tube. After finishing, the tube slides off one end without touching.

Buffing Flat Plates

Flat plates are another type of job difficult to finish without marking with the fingers. We will assume them to be brass plates, one eighth thick and four inches square to be polished on one side. They may, of course, be held in the finger tips but it is far better to mount them on a board. The best way is to cut a piece about twelve inches long and shape one end into a rough handle. Drive four pins into the board near the other end and make a saw cut right from the handle end to within an inch from the end in the middle of the board. When a plate is placed between the pins and the handle gripped the work is held tightly.

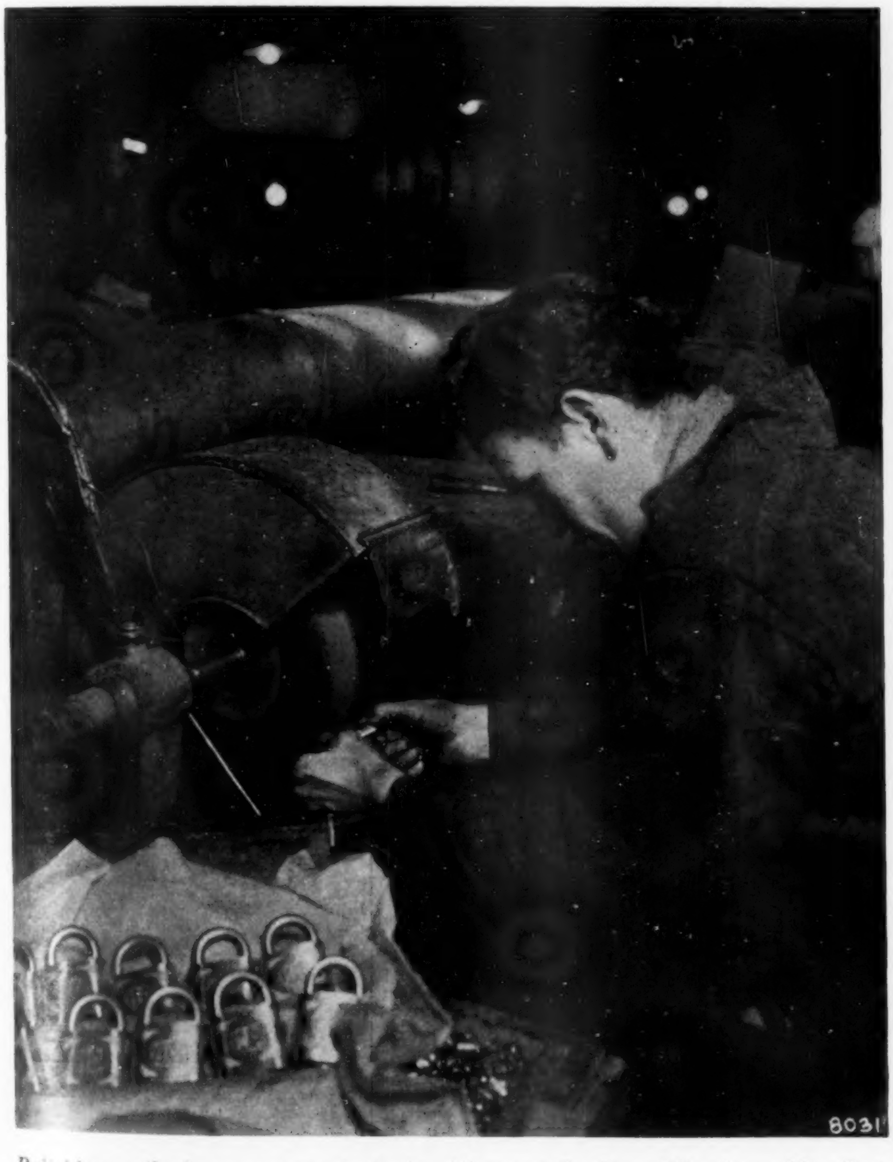
Another good way is to cut a shallow depression in a board that will take the plates a tapping-in fit. A hole through the board in the center of the depression enables the plates to be knocked out from the back with a nail or similar object. This is a good way when the number of pieces is not great; so is the method of polishing the corners first and jabbing two opposite corners into the ends of pieces of soft

wood. These hold quite tightly and do not mark the work at all.

Finishing Assembled Pieces

Assembled pieces like brass chains, hinged covers or sliding telescopic parts are rather difficult to hold. Loose pieces like these are hard to control as well, but there are a few pointers worth knowing. To finish short chains I wrap them around a board and buff them in the same direction as they are wrapped, while holding the end links. Then I unwrap them and wind them around again on the side. It is possible in this way to buff a chain while it is more or less solid with no part of it flapping around. Hinged covers I place face to face, two at a time, with the hinges at right angles to each other so that neither can close when they are pressed against the wheel. The double thickness, also makes it easier to hold them by the edge. Telescopic parts are best when pulled out to their full length and buffed towards the ends from the middle as the force of the wheel tends to keep the parts extended whereas if they are buffed the other way they are likely to snap together suddenly.

It is not contended by the writer that these are the best methods known. They are only the best known to him and are original, and this is the first time they have been presented. Manufacturing in the mass is, of course, different. In such cases it might pay to use more elaborate devices. For the ordinary run of work, however, it is hardly profitable to spend much to avoid finger marks and that is why I use each of the methods I have explained; it is inexpensive to make and use.



Polishing padlocks on contoured wheels. (Courtesy Lockwood Hardware Mfg. Co.)

Joining Copper and Lead

Q.—We are manufacturing a statuary bronze finished sheet copper base, to which we wish to join a cast lead bracket which has also been finished. The joint is to be permanent. Please tell us the best method of assembling these two parts. We do not wish to use rivets or screws but prefer to use some cold cement or low temperature solder.

A.—There are numerous low temperature solders that might serve your purpose. We suggest that you try them on samples of the two metals that you are fabricating. Lead melts at 625 deg. F. and copper at 1980 deg. F. To get a low temperature melting, alloys must be made by using tin that melts at 447 deg. F. with bismuth that melts at 504 deg. F. and cadmium melting at 608 deg. F.

The compositions of some of the alloys that you might test are given below. Give special attention to mixture No. 2 as it is hard and rather strong.

Lead	Tin	Bismuth	Cadmium	Melting Points
1	1½	..	..	334°F
1	1½	1	..	284°F
5	3	8	..	212°F
6	..	7	1	180°F
2	4	..	2	180°F

A liquid non-metallic cement might be tried also. Inquire of any of the manufacturers of plastics.—W. B. FRANCIS.

Matte Finish

Q.—How can we get a matte finish on bronze?

A.—The use of a matte dip as follows is recommended:

Nitric acid 50%
Sulphuric acid 50%

Saturate with zinc sulphate to obtain a matte finish. Dip must be used hot, therefore a good grade of asphaltum resist must be used. Due to the matte surface scratching easily some doubt as to its applicability on your work.

It is possible that work can be shielded with a metal shield and given a satin finish with a hangar brush, which is brush used on sample sent. It is also possible that a greaseless compound can be used.—G. B. HOGABOOM, JR.

Shop Problems CASTING • METALLURGICAL

FABRICATION • ASSEMBLING • • PLATING • FINISHING

Questions from readers relating to shop practice and answers by our associate editors

Leaky Aluminum Tubes

Q.—A customer is having trouble with their aluminum X-Ray tubes. They leak oil under about 10 lbs. pressure.

Is there a pickle, or any way that they could be treated to save those that are made? What would be a good aluminum mixture to prevent the trouble?

We have been using No. 12.

A.—The alloy designated as S. A. E. 35, which contains 95% aluminum, 5% silicon, would be more suitable for your purpose. It does not machine as well as No. 12 but the castings are more leak-proof. For salvaging porous castings, bakelite varnish or solutions of sodium silicate (water glass) have sometimes been used. Neither is recommended except as the last resort in an emergency. According to Corse, a solution of phenol-formaldehyde resin (bakelite) in alcohol should be forced into the casting at pressures of 200 to 300 lbs. per sq. in. at different temperatures and for different lengths of time, depending upon the job.—H. M. St. J., Problem 5,635.

Lowering the Cost of Plating

Q.—Can you advise the cheapest and best way to cut the cost of the old style polishing flash copper, nickel, buff, and then chromium.

A.—If the work being plated is steel stampings, considerable time can be saved in the polishing if the stampings are made from steel sheet with a high finish. The extra cost of such steel is usually more than offset by the savings on the wheel. This type of work can be plated in any of the bright nickel solutions now on the market, and if not of an unusual shape or character, the pieces can be transferred directly from the bright nickel into the chrome thus eliminating all polishing.

For rough, dirty, or pitted metal there is still an advantage in using the cyanide copper flash, but in many cases this can be eliminated and a heavy direct nickel applied. In order that the nickel be capable of taking as good a color as would be had from a copper plate, color, nickel plate, color, finish, it is necessary to put on a heavy nickel. This can be done in production by making use of the Watts type nickel solution, such as given on pages 21 and 22 of the 1937 edition of the Platers Guidebook. These solutions will plate 2 to 3 times as fast as the room temperature solution. The cost of the extra nickel will be less than the cost of the extra copper plate color step, and in addition the heavier nickel deposit will provide better protection of the work.

Methods of cutting the cost of finishing can best be discussed using a specific example and we do not know the type of work you are most interested in. Polishing costs can sometimes be reduced by using a satin finish instead of a finish to color, as in the former it is not necessary to cut down below all imperfections in the metal.

Use this Blank for Solution Analysis Information

Fill in all items if possible.

Date ....

Name .... Class of work being plated: ....

Address .... City .... State .... Volume used: ....

Employed by: .... Solution depth: ....

Kind of solution: .... Cathode surface, sq. ft.: ....

Tank length: .... width: .... Kind of anodes: ....

Anode surface, sq. ft.: .... Distance from cathode .... Original formula of solution: ....

REMARKS: Describe trouble completely. Give cleaning methods employed. Send small sample of work showing defect if possible.

Use separate sheet if necessary. ______________________________

NOTE: Before taking sample of solution, bring it to proper operating level with water; stir thoroughly; take sample in 2 or 3 oz. clean bottle; label bottle with name of solution and name of sender. PACK IT PROPERLY and mail to METAL INDUSTRY, 116 John Street, New York City.

Many articles now plated in still tanks and hand polished could be handled in plating barrels and ball burnished at lower cost, but the application of such methods depends on the quantity of work being handled, desired finish, and other factors.—G. B. H. Jr., Problem 5,636.

Nickel on Brass Eyelets

Q.—We are having trouble with our nickel solutions in this respect: when we nickel plate small diameter, long shank eyelets, similar to the samples enclosed, we find that in "crimping" these eyelets the customer complains that instead of the end rolling over as it should, it "buckles" the eyelet and this is very objectionable.

We are enclosing herewith samples showing the brass eyelet both before and after crimping, also the brass, nickel plated eyelet. The brass eyelets do not buckle up when crimping, but with the brass, nickel plated eyelets, one out of every three buckle.

Our impression is that the nickel is hard and prevents the brass from coiling, or crimping, thereby putting the strain on the rest of the barrel and causing a buckling at some point. We are listing herewith the solution that we are using and if you have any suggestions to make will be glad to hear from you.

Nickel salts 16.5 ounces per gallon; boric acid 3 ounces; ammonium chloride 4 ounces; alkalinity 6 CC (U. S. Research Corporation testing method); amperage 75; temperature 75°; time of plating (barrel plating) 45 minutes. We use cadmium as a brightener and we plate about 55 pounds of these eyelets at one time.

A.—If nickel is the cause of the buckling, as it appears to be from your own tests, then it is advised to produce a softer nickel by looking into a method for elimination of the use of cadmium as a brightener.

Nickel deposits produced with cadmium as a brightener are always hard and brittle. Most brighteners when used in a solution run at room temperature will cause hard nickel.

One method of obtaining a bright soft nickel on the class of work described is to use a plain room temperature nickel solution (formula as given is all right, except that a pH of about 6.0 should be used. Do not know if your method gives this). The plating is done without the use of a brightener, and the work is tumbled on itself using soap and water to bring up the required brightness. No steel balls should be necessary.

This method can be used with your present solution as the cadmium will plate out in time.—G. B. H. Jr., Problem 5,637.

Peeling Nickel

Q.—We are striving for a soft nickel because after the work is plated (steel skates) the runners and edges, part way up are machined off, down to the steel. The work is copper plated and buffed, and of course cleaned properly, nickel plated and buffed, then wiped clean, chromium plated and buffed, then ground. The work has tendency to lift and peel off.

What constitutes a soft nickel, and how to control same?

A.—In answer to questions on obtaining a soft nickel it can be said that one important point is to keep the pH at the right value. If the pH goes too high the nickel will become more brittle. A good pH value is from 5.8 to 6.0.

Too low a solution temperature or insufficient boric acid will also cause brittle nickel deposits. The temperature should not be allowed to go much below 65 deg. F. The boric acid should be held at around 3 ozs. per gallon.

Brittle nickel deposits can also be caused by the presence of small amounts of impurities, such as zinc, copper, iron, cadmium, and organic additions such as may be used to obtain a bright deposit.

The cause of the peeling in your case may be due to some point in the cleaning as well as to a brittle nickel. It is not stated whether nickel is peeling from the copper or whether copper peels from the steel. If the former, then trouble may lie in cleaning of the copper after buffing such as the improper rinsing off of cyanide used as a dip before nickel plating. A good method to use to rinse off cyanide is to first rinse well in running water and then dip in a nickel solution that has been made acid, about pH 5.2, with sulphuric acid. Then transfer work directly into nickel plating solution.

If plating is peeling down to the steel, an electrolytic pickle of the steel in a 32 deg. Baume sulphuric acid solution using work as cathode, lead anodes, for ½ to one minute, can be used. Nickel plate directly on the steel. A heavy nickel plate can then be colored up for finish, eliminating the cyanide copper.—G. B. H. Jr., Problem 5,638.

Plating Stainless Steel

Q.—We are faced with a problem of making some stainless steel parts absolutely non-corrosive. Will you please advise whether or not it is practical to chrome plate stainless steel parts regardless of the alloy and whether they may be plated immediately after they are fabricated without any polishing?

A.—If the stainless steel being used has a tendency to corrode in the application in question then the use of a chromium deposit probably would not provide much additional protection in itself due to the fact that a chromium deposit is normally very porous.

To obtain a corrosion resistant coating a nickel plate can be applied. It is possible, although care is required to nickel plate stainless steel, by following the method described by G. E. Gardam in a paper he presented before the Electrodepositors Technical Society in London, England.

The method consisted in first cleaning the steel well by the usual cleaners and then plating in a solution composed of:

Single nickel salts ..	240 grams
Sulphuric acid	50 grams
Water	1 liter

Use at 30 to 40 degrees C.

Electrolyze for 5 to 10 minutes at a current density of 150 amperes/sq. ft.

In this treatment the strong evolution of gas and the effect of the electrolysis removes any oxide film, and at the same time a thin film of nickel is deposited.

The work is transferred directly from this to the nickel solution.

As regards the corrosion resistance of stainless steel, this material will not exhibit its resistant properties unless it is properly polished. The correct polishing procedure should be obtained from the manufacturers of the steel.

After applying a nickel deposit as described a chrome plate can of course then be used for a finish.—G. B. H., Jr., Problem 5,639.

Metal Casting Digest

Short abstracts of articles of interest to practical non-ferrous foundrymen and metallurgists

By H. M. ST. JOHN
Associate Editor

Trends in the Non-Ferrous Foundry. L. B. Hunt. Metal Ind. (London), June 18th, 1937, page 687. The article discusses improved materials and methods. "Increasing precision and control, with careful planning are taking the place of empirical and individualistic methods." The competition of castings with wrought metals and pressure die castings is discussed.

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Structure and Characteristics of Aluminum Alloys. H. C. Hall. Metal Ind. (London), June 25th, 1937, page 705. The structure, casting properties, and physical strength of aluminum alloys after various treatments are discussed.

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The Use of Nickel in Non-Ferrous Alloy Castings. Part II. J. O. Hitchcock. Metal Ind. (London), June 25th, 1937, page 710. The article gives detailed information regarding aluminum alloys containing nickel, the cupro-nickels and nickel-base alloys.

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The Recovery of Copper from Brass and Bronze Scrap. E. J. Kohlmeyer. Metallwirtschaft, Vol. 16, page 220 (1937); Chemical Abstracts, June 20th, 1937, col. 4240. To avoid the metal losses in the slag which occur when the scrap is "blown," the zinc is volatilized from the molten scrap by uniform and prolonged heating in a rotary furnace. No slag is formed because the charge is protected by the neutral atmosphere formed by the burning Zn-ZnO vapor. Tin and lead are not volatilized. Pure copper can be recovered after the zinc removal by "blowing" with air to convert the tin and lead to copper stannate and lead oxide, or by "blowing" with air in the presence of coke to volatilize the tin.

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A Noteworthy Example of Inverse Segregation. W. Claus. Z. Metallkunde, Vol. 28, page 391 (1936); Chemical Abstracts, June 20th, 1937, col. 4243. Alloys of 85 and 72% copper with tin, lead and nickel were studied by chemical analysis and radiographic methods and it was shown that inverse segregation is related to stresses generated during cooling.

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Gates and Risers on Small Non-Ferrous Castings. J. M. Douglas. Foundry Trade J., Vol. 56, page 293 (1937); Chemical Abstracts, June 20th, 1937, col. 4246. A review.

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Melting and Annealing of Electrical Alloys. D. F. Miner and J. B. Seastone. Metal Progress, June 1937. Among the alloys discussed is cupaloy, an age-hardenable copper alloy. Chromium is added to molten copper in the furnace, in the form of a chromium-rich copper alloy. In order to avoid excessive loss of chromium, the hardener is made in a high-frequency electric furnace at high temperatures. Similar furnaces are used in making the final alloy.

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Heat-Treated Copper Castings Alloyed with Zirconium and Beryllium. Anon. Metallurgia, July, 1937, page 83. Results of investigations are given which show that the alloys of copper and zirconium have high electrical conductivity, especially after suitable heat treatment. In conjunction with beryllium, zirconium increases hardness slightly, but diminishes the degree of softening at temperatures which seriously affect the hardness of heat-treated beryllium copper.

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Development of Light Alloy Bearings. Anon. Metallurgia. July, 1937, page 103. Both magnesium-base and aluminum-base alloys have been used with fairly satisfactory results. Suitable alloys have been produced for both light and heavy duty, for use with either soft or hardened journals.

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New Copper Alloys, Age Hardened, Have High Conductivity. T. S. Fuller. Metal Progress, July, 1937, page 51. Two new copper-beryllium alloys have recently been developed, one containing 0.4% beryllium with 2.6% cobalt, the other 0.1% beryllium with 0.4% chromium. The cobalt alloy, quenched from 1650°F and reheated at 935°F, has 90,000 lbs. tensile strength, 10% elongation, 220 Brinell hardness, and an electrical conductivity 45% that of copper. The chromium alloy, quenched from 1700°F and reheated at 935°F, has 30,000 to 35,000 lbs. tensile strength, 10 to 15% elongation, 80 Brinell hardness, and an electrical conductivity 72 to 75% that of copper.

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The Importance of Melting and Casting Temperatures During the Production of Aluminum Castings. E. T. Richards. Giessereipraxis, Vol. 58, page 50 (1937); Chemical Abstracts, July 10th, 1937, col. 4627. Rapid solidification contributes to high tensile strength. The tensile strength of one alloy decreased from 14 kg. per sq. mm. with a casting temp. of 650°C to 11.20 kg. per sq. mm. cast at 870°C. The tensile strength of an 8% copper alloy cast at 703°C decreased from 14 kg. per sq. mm. in a section of 10.2 mm. diam. to 9.5 kg. per sq. mm. in a section of 25.4 mm. diam. The melting temp. should be no higher than necessary to give a homogeneous melt, about 650° to 750°C.

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Laboratory Research on the Re-Usability of Low-Zinc Bearing Metal. Aug. Graebing. Braunkohle, Vol. 35, page 613 (1936); Chemical Abstracts, July 10th, 1937, col. 4628. Operating behavior of 5 bearing metals indicates the inadvisability of additions of used metal to new in the pouring of bearings.

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Structure and Characteristics of Aluminum Alloys. Part II. H. C. Hall. Metal Ind. (London), July 2nd, 1937, page 9. An illustrated review which deals with both theory and practice, comparing the RR series and Y alloy with other aluminum alloys, and dealing particularly with the influence of composition on the soundness and physical properties of castings.

Modern Production Equipment

New processes, machinery and supplies for metal products manufacturing and metal finishing

Low Voltage Generator Sets with Automatic Voltage Control for the Anodic Treatment of Aluminum

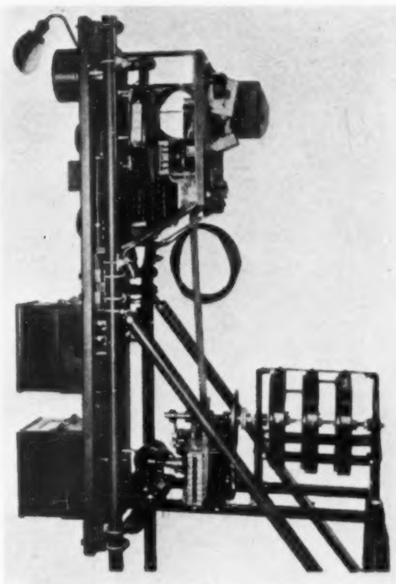
The Hanson-Van Winkle-Munning Company, Matawan, N. J., manufacturers of electroplating equipment and supplies, recently completed the first two units on an order for eight motor generator sets to be used in the anodic treatment of aluminum parts. These sets are unusual in that they are larger than sets ordinarily used in the past and are equipped with automatic control devices, designed to vary generator voltage through a predetermined cycle of values as required for the specified treatment of a batch of aluminum parts.

The normal rating of the generators is 1500 amperes at 50 volts on the basis of continuous operation. They are driven by 125 H.P., 600 r.p.m., unity power factor, synchronous motors mounted directly on one end of the generator shaft and have 125 volt exciters mounted directly on the opposite end of the shaft. The common sub-base, motor and generator rings, etc. are built of heavy steel shapes and plates fabricated by electric arc welding.

The generator control panel includes the regular indicating instruments and equipment for visual and manual control consisting of ammeter and voltmeter, generator and exciter field rheostats, start-stop push button and for the motor starting contactor and generator field switch with discharge resistor. The automatic control consists essentially of a motor driven field rheostat and timer manufactured by the Ward Leonard Electric Co. and graphic recording ammeter and voltmeter manufactured by Roller Smith Co. Auxiliary equipment includes overload and reverse current relay and indicating and signalling devices.

Front view of control panel for the motor-generator set for anodic oxidation of aluminum.

For normal operation, parts to be anodized are cleaned and hung in the anodizing bath and the operator simply presses a button to set the automatic control in operation. The

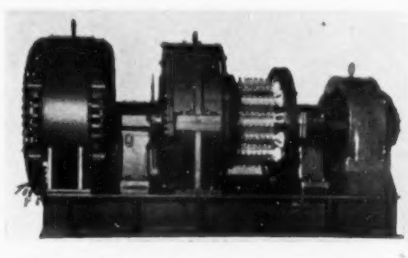


Side and rear view showing construction details

motor driven field rheostat increases generator voltage from 5 to 40 volts in a period of 8 minutes. On the completion of the 8 minute treatment the motor driven field rheostat comes to rest and a synchronous motor driven timer starts to operate. The generator voltage is held at 40 volts until the timer completes its operation (normally 30 minutes, but adjustable from 1 minute to 36 minutes) at which time the generator field circuit is opened and a warning signal announces to the operator that the treatment cycle is completed. The control automatically resets to its starting position.

During the treatment cycle the voltage and current are recorded by the graphic meters on strip charts which are dated and numbered to correspond with the batch number of parts treated. These charts plus a similar temperature chart and a record of the solution analysis constitute a complete record of the treatment of each batch and a guarantee that the treatment was in accordance with specifications.

In case of a short circuit in the anodizing tank or an overload from any cause the generator voltage is automatically reduced to a very low value to protect the equipment from injury. It may be restored at once to its normal operating condition upon removal of the cause of overload condition.



H-VW-M motor-generator set for the anodic treatment of aluminum parts; 1500 A.; 50 V.; 125 HP.

Latest Products

Each month the new products or services announced by companies in the metal and finishing equipment, supply and allied lines will be given brief mention here. More extended notices may appear later on any or all of these. In the meantime, complete data can be obtained from the companies mentioned.

Universal Grinding Machine. Tool room equipment for producing the best grade of finish with a high degree of accuracy, flexibility and ease of operation. Cincinnati Milling Machine and Cincinnati Grinders, Inc., Cincinnati, Ohio.

Thermal Analizer. A direct reading dilatometer for measuring dimensional changes of material during heat changes. The Stanley P. Rockwell Co., Hartford, Conn.

Self-Locking Screw Thread Profile, with improved features. Dardelet Threadlock Corp., 55 Liberty St., New York City.

Two or Three Step Control; for controlling the temperature of cleaning, plating solutions or annealing furnaces. Highly flexible operation by the use of two switches instead of one. Burling Instrument Co., 241 Springfield Ave., Newark, N. J.

Hydromatic Drain Pipe Cleaner; clears slow-running, sluggish or clogged drain pipes. Parker S. Atwood, 6 Bradley Ave., East Haven, Conn., Eastern Distributor.

Spectrographic Laboratory; to determine what use prospective customers can make of spectrographic analysis and also to train the customer's technician in its correct operation. Harry W. Dietert Co., 9330 Roselawn Ave., Detroit, Mich.

"Forewarn" Metal Detector

For many years, prisons and other penal institutions have profited by the safety afforded by "Forewarn" detector equipment in preventing the smuggling of guns, files, sawblades and other similar articles into the institution. Doorways have been equipped to permit searching of visitors and inmates, and in addition, facilities are provided for frisking mattresses. As an auxiliary, a small hand search unit for localized search is available.

The "Alnor" forewarn detector equipment, manufactured by Illinois Testing Laboratories, Inc., Chicago, Ill., has been modified and adapted and is now offered for industrial use to detect the presence of tramp iron or steel in various products or materials.

Because of its versatility, it is stated, the applications are unlimited. Wherever it becomes essential to locate concealed iron and steel of any form, whether it be in a continuous or intermittent process, the forewarn metal detector may be used advantageously. In a simple intermittent search process, bundles or packages of material are passed by hand through the search coil opening, for examination. They are not left in the opening, but merely passed through as one would pass a package over a counter. Presence of iron is announced by a visible and audible signal. Typical of this method of search is the installation made for examining bales of scrap brass for tramp iron prior to resmelting. Fully automatic protection can be obtained by installing metal detectors on conveyor belts. Presence of tramp iron on the belt causes a momentary reversal of the conveyor system with a consequent discharge of the contaminated material.

The Detector consists of three distinct parts; the search coil, the amplifier, and the supervisory signals. Amplifier and signals may be made an integral part of the coil system, or they may be remotely located. Full

Alnor "Forewarn" metal detector

supervision of operation is built into the amplifier so that failure of tubes, transformer, relay or coil system is immediately revealed. A micro-control permitting easy adjustment of sensitivity of the search system is standard.

Respirator

The Dustfoe Respirator, a newly developed respirator (bearing U. S. Bureau of Mines approval No. 2115), weighing less than 3¼ ounces in weight, providing full protection with utmost comfort under the most severe working conditions, has just been placed on the market by the Mine Safety Appliances Company, Braddock, Thomas & Meade Streets, Pittsburgh, Pa.

The Dustfoe Respirator allows full vision in any direction, does not interfere with the wearing of goggles, spectacles, welding helmets or head-coverings of any kind and may be worn for long working periods with entire comfort. All metal parts are made of aluminum, can be quickly replaced, and may be thoroughly sterilized at any time, including the easy fitting, soft rubber face-cushion.

The new two-element Dustfoe filter, it is stated, will eliminate dust particles even as small as one micron (1/25,000 inch) in size with highest efficiency and unnoticeable breathing resistance. Replacement of filters is simple and requires but a few seconds. Low-cost of cellulose filters assures economical maintenance.

A complete description and illustration of this new respirator may be found in bulletin No. CM-1 copy of which can be had by writing this magazine or the manufacturer direct.

MSA Dustfoe respirator

Varied Buffing Compositions

In recent years the Buckeye Products Company, 7020 Vine St., Cincinnati, Ohio, has developed a highly specialized line of Speedie buffing and polishing compositions; a complete selection of compositions. This group includes tripoli, lime finish, stainless steel, chrome, grease stick, emery cake, etc. The Cincinnati plant has the most modern machinery so that absolute uniformity is guaranteed for all grades of compositions. All of the men now in the employ of the company have been associated for more than ten years and several veterans have twenty and twenty-five years of service.

Removing Carbonates from Cyanide Solutions

A new material for use in removal of carbonate from plating solutions, to be known as "Du Pont Carbonate Remover," is announced by the new Electroplating Chemicals Division, E. I. du Pont de Nemours and Company, Wilmington, Del. A calcium sulphate compound of slight solubility, it is a precipitation agent which can be maintained in excess at all times, permitting continuous disposal of carbonate as it is formed.

The product is described in a new Electroplating Service Bulletin just issued by the Company. It outlines the chemical analysis of carbonates and the results of laboratory and commercial tests conducted with solutions of cadmium, copper, zinc and silver.

New pH Papers

Paul Frank, 546 Fourth Ave., New York City, announces that he now has available two new numbers in pH papers covering the neutral and slightly alakaline zone. These numbers are: No. 6681—pH 6.6 to 8.1.

No. 8297—pH 8.2 to 9.7.

Very shortly, a new special pH paper will be brought out for bright nickel solutions; pH 1.8 to 3.3.

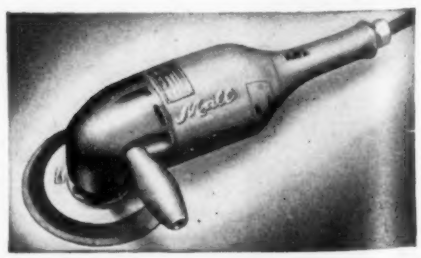
Universal Electric Disc Sander

The Mall Tool Company, 7740 So. Chicago Ave., Chicago, Illinois, announces a new portable universal electric disc sander, a valuable addition to their line of flexible shaft equipment and portable power tools.

This disc sander has a heavy duty ball bearing motor that operates the sanding disc at 4500 r.p.m. It is fast and powerful, comfortable in the hands, and is easy to operate and control. It is the ideal disc sander for constant production work.

This new Mall unit is packed individually in a heavy cardboard container. Standard equipment includes 20 ft. of 3 conductor cord and rubber plug, a heavy duty switch, a 7" pad, and one abrasive for metal sanding.

This unit is recommended for grinding and smoothing down welds, steel and iron castings, auto body and fender work, and removing rust and scale. If desired, a cup shaped grinding wheel or wire brush can be substituted for the pad and abrasive disc.



Mall Universal electric disc sander

Plating on Aluminum Parts

William J. Travers, a Buffalo, N. Y. electrochemist, was recently finally granted a patent covering a process of plating aluminum and aluminum alloys, which has been licensed to a number of large manufacturers, among them the Eastman Kodak Company of Rochester, N. Y. Chief among the features of the process is that the plating may be applied successfully by practical platers of all common metals using the same equipment, ordinary current density and ordinary time values.

It is stated that the bond that is established between the article and the film of metal appears not only to resist to a high degree all of the methods used in testing, including the salt spray, but also shows extreme insensitivity to severe temperature

Various aluminum sand and die castings plated by the Travers process

after brief instruction and with the plating equipment found in what might be called the "garden variety" of plating room.

Mr. Travers initiates his process by establishing a thin anodic film over the surface of the article to be plated. This is done in a few moments time in a mild acid bath using a low current density. The film is then modified in an alkaline solution. After this, the article may be plated in the manner changes however sharp they may be. Any one of the common metals may be used to cover aluminum.

Aside from their improved appearance, aluminum articles plated with a metal like chromium show a tremendous resistance to wear and abrasion. The process is controlled by Krome-Alume, Inc., 68 Locust St., Lockport, N. Y.

High Purity Tin Anodes

The R & H Chemicals Department of E. I. duPont de Nemours & Co., Inc., Wilmington, Dela., announces the development of high purity tin anodes for alkaline plating under the duPont trade mark, Pur-o-Tin. These anodes, said to be superior to Straits tin, are cast from Vulcan's super-refined tin and tests 99.99+%.

The high purity of these anodes recommends them for plating work as it eliminates the possibility of impurities building up in the solution to the point of depositing out on the plated work. Pure tin coatings have a higher resistance to corrosion, a property desirable for food containers, cooling coils for pasteurizing and other dairy equipment.

The Pur-o-Tin anodes are made in standard shapes for still and barrel solutions, and also special shapes for special conditions.

Air Drying Aluminum Synthetic

The Stanley Chemical Company of East Berlin, Connecticut, announces a new air drying aluminum synthetic which is tack free in 20 minutes. This material which is their No. 66E-656 aluminum synthetic, is said to be of exceptional brilliance and to have excellent adhesion, durability and weathering qualities.

It is also said to have exceptional flow and dipping characteristics and to impart a bright smooth finish in a one-coat job; free from sags, runs or drips. On dip application the material should be used without reduction while for spray application it should be thinned to meet specific requirements. The material does not settle out; only normal stirring is required before use.

No. 66E-653 was first used on sled runners this past season by one of the country's largest manufacturers of juvenile toys and playground equipment, as long baking at extreme temperature is unnecessary with this air drying material, production schedules can be materially increased.

Metal Powders

Handy & Harman, 82 Fulton St., New York, announce the formation of a Metal Powder Products Division which, as the name indicates, will engage in the development and manufacture of products which are fabricated from metallic powders. This division is the result of several years of research with metallic powders, during the course of which processes have been developed for the manufacture of a series of workable powder compositions designed for specific electrical applications in the form of sheet, strip and wire. *Gregory C. Comstock* has been appointed Manager of this department.

Continuous Strip Grinder

The Mattison No. 464 continuous strip grinder is designed for grinding strip coil through the use of factory coated abrasive belts. For example, after hot rolled coils are pickled, annealed and cold reduced, strips that show any imperfections are ground by the Mattison No. 464. Also after each additional cold reducing operation, coils that will not pass inspection are ground before annealing and pickling.

On this grinder, power driven reels are placed at each end of the machine from which the strip passes guiding rolls, and over the work support roll. Work support roll is air actuated with quick movement for disengaging the work from the belt. Ample movement is provided to allow extra room for passing the strip under the belt in loading. Grinding roll is cushioned and has adjustable grinding tension. Belt is driven from both ends, so it can be run in either direction, according to direction the strip is traveling. The flexing of the strip as it passes over the support roll and the point contact of the grinding roll provide for fast-cutting belt action, and duplicates the action of the wide belt grinders on wide sheets. Made in widths for grinding 12", 18", 24" and 36" wide strip.

This machine is made by the Mattison Machine Works, Rockford, Illinois.

Mattison No. 464 continuous strip grinder

Reflectometer

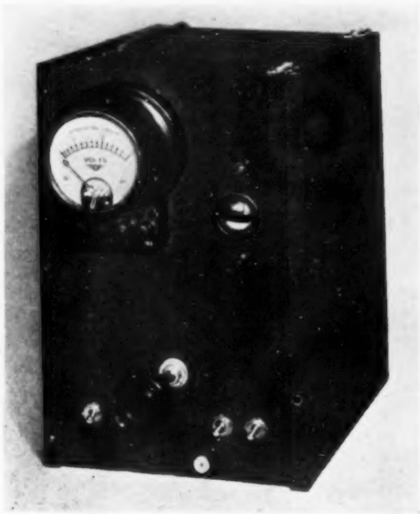
The Republic Chemical Machinery Co., 154 Nassau St., New York, under the guidance of its supervising engineer, A. Brothman, has just developed a device for the measuring of light reflection from metal as well as other types of surfaces. Because, above anything else, the reflectometer was designed for testing on a practical scale and because it was realized that in the every-day practice of any factory there is the necessity for living up to certain "standards" or "types," the measurement of the light reflected has not been translated into standard light intensity units, but, instead, the test has been put on a purely comparative basis. In actuality, the machine tests or determines that intensity of light which it is necessary to "play" upon the particular surface which is being tested in order to achieve, at any pre-determined angle of light incidence, a certain set intensity of reflection.

This effect has been attained in the following way:

Located directly beneath an objective or focusing column is a panel-holder which is capable of being varied through any angle, formed with the line of the afore-mentioned column, from 90° to 180°. The column contains a set of lenses whose function it is to focus the light reflected by the panel of tested material (reflected to the column) upon a photocell located at the top of the column. The intensity of light which is directed at the panel is fixed by means of a variable resistor placed in the circuit of the lamp-bank which is used as a light source. The photocell is wired in such a fashion to a resistance-coupled voltage amplifier so as to produce, when sufficiently activated by reflected light, a signal which the amplifier is capable of building to a bias of minus seven volts. The aforesaid bias is delivered to the grid of a cathode ray tube. Upon reception of the bias as stated above, the shadow in the cathode ray tube, which under normal operating conditions is wired to a spread of a 90° angle, is closed to a 0° angle.

The method of operating the device, as can be gathered from what has already been said, is to place a panel of the material to be tested in the panel-holder, taking care always that the panel-holder remains in the same angle in which the preceding tests have been made (this is made possible by means of a protractor which is attached to the panel-holder and which can be referred to the brace holding the panel-holder), and to vary, with the variable resistor, the intensity of light directed at the panel until a 0° angle shadow is achieved in the cathode ray tube. Naturally, the quantity of light which is necessary to produce a complete closing of the shadow in the cathode ray tube is a constant. Therefore, the reading on the voltmeter which is hooked in parallel across the lamp-bank is an indirect though precise measurement of the reflectance value of the surface involved since the voltage across the lamp-bank is directly proportional to the intensity of light emitted by the lamp-bank and brought to bear upon the tested material.

It is notable that the arrangement in which the panel-holder can be varied through a wide array of angles with regard to the focusing column makes it possible to measure the reflectance value of any particular surface in any number of angles, thus making accessible the calculations of a mean reflectance value for that surface. Moreover, it is readily seen that when the panel assumes that position in which it describes the most obtruse angle possible with the line of the column, the reflected light which



The Republic reflectometer

is then being measured is the light reflected along the line of the panel, or, in other words, the gloss of the panel.

To the metal industry, the reflectometer offers a refined technique for measuring the extent of polish of a surface, for comparing the plating of surfaces, for measuring the reflectance from lacquered or enameled surfaces and for measuring the gloss of finished surfaces.

Among the many advantages claimed for this device are the qualities of compactness and easy operation in addition to sturdiness. Also, not the least of its attractions, is the fact that it may be run off any 110 volt line, thus eliminating the cumbersomeness attributed to the many electrical instruments which are operated by dry-cells or storage batteries.

Non-Hardening Plastic "Putty"

A new plastic compound has been developed by Maas & Waldstein Company, 438 Riverside Ave., Newark, N. J., to take the place of putty and other substances used for cementing glass to glass, metal or wood, calking crevices, making joints of various kinds, and other purposes.

This new compound, which is known as "Plasticalk", does not, like putty, dry, harden, crack, shrink, and lose its bond with age, but is said to retain its plasticity and adhesiveness indefinitely and to be unaffected by water or humidity; does not support fungus-growth. It is easily applied with an ordinary putty knife, and, when in place, will not sag or flow, even if heated by a nearby electric lamp. It adheres strongly to glass, metal, and wood, and seals made of it remain tight in spite of exposure to moisture and to wide variations in temperature.

Vacuum Cement

A cement for vacuum furnaces which does not become brittle, adheres to any surface and can be reused indefinitely, has been developed by the Westinghouse Electric & Manufacturing Company recently.

This cement is solid at room temperature, but at higher temperatures becomes increasingly softer. It does not deteriorate in any way with use, so it can be reclaimed, the fragments melted together and used again and again without limit. This cement is highly tenacious and will stick to rough or smooth metal, glass and quartz surfaces to form vacuum-tight joints.

In applying it to a vacuum furnace, the cement is smeared over the joints of the cap closing the inner chamber of the furnace. A torch is used to make the compound flow readily and a heated putty knife to spread it.

This cement can also be used as a paint by using carbon tetrachloride as a solvent. In this form it can be painted on and a layer of the desired thickness built up.

Knapsack Sprayer for Dust

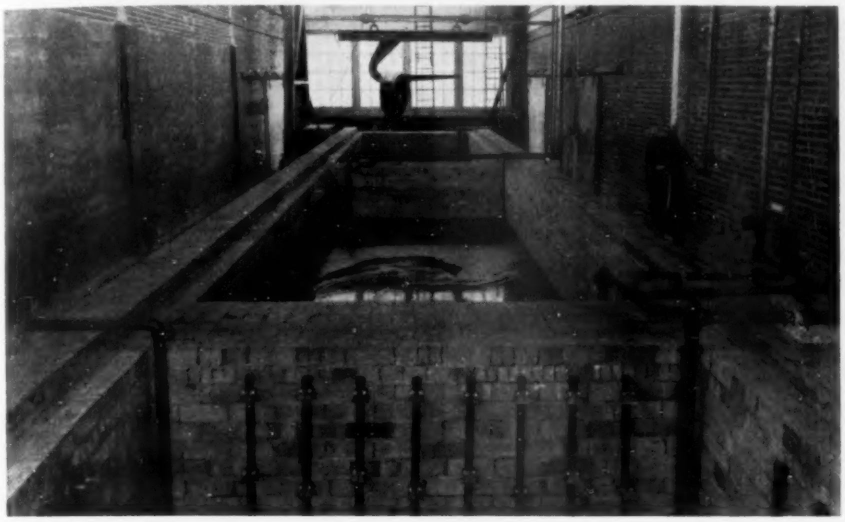
To combat the nuisance of floor dust which accumulates in foundries, and manufacturing plants it has long been a practice to use oil sprays. For this purpose, the new Hudson "Du-More" Sprayer is said to provide a practical, low-cost method. This knapsack-type sprayer, with a form-fitting tank, is carried comfortably on the back with wide, adjustable shoulder straps. It is equipped with an adjustable nozzle; and to handle even the heaviest oils, powerful diaphragm pump maintains a continuous high pressure for the efficient breakup of oils into a fine, penetrating spray. The pump mechanism is operated by a right-hand lever, providing easy action and full pressure until the tank is empty. The spray is directed by the left hand, enabling the operator to move around the floor with perfect ease as he works. The 4-gallon tank, which is available either in prime galvanized iron or copper sheet, has a removable top for easy filling. An automatic shutoff lever is provided at the handle of the extension rod, so that the operator may make the most efficient use of spraying oil without waste. A descriptive folder is available on request.

The Du-More Sprayer is made by the H. D. Hudson Manufacturing Company, 589 E. Illinois Street, Chicago, Illinois.

"Du-More" knapsack sprayer to lay dust

Acid Proof Material for Tanks

Basolit is the trade name of a quick-setting acid proof cement used for tank construction, made by Nukem Products Corporation, 70 Niagara St., Buffalo, N. Y., recommended for pickling and plating tanks. It melts at about 250 deg. F. and is absolutely immune against con-



Nukem "Basolit" pickling tank

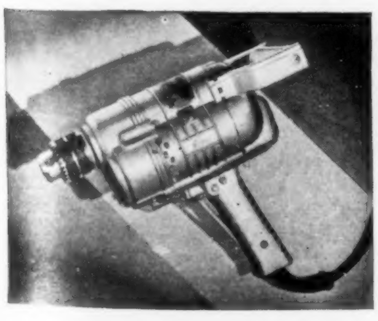
centrated or diluted hot or cold sulphuric, hydrochloric, hydrofluoric, acetic and lactic acids and against 30% nitric acid solution. It hardens within a few minutes after application and is then ready for use. Compressive strength, 10,000 to 12,000 pounds per square inch; electrically non-conducting.

The method of preparation is as follows: heat in a pot or kettle over a slow fire. At 250 deg. F. Basolit begins to melt, becomes liquid and is then ready for use; keep the kettle well covered and stir the material from time to time, keeping temperature below 320 deg. F. At that point Basolit becomes pasty but turns liquid again at reduced temperatures. Pour the Basolit into the joints where required when it is a thin flowing liquid.

Basolit is also used for acid proof floors, patching, grouting and electrical insulation.

Half-Inch Portable Electric Drill

Reduction of weight and size to half the former standards for half-inch capacity drills, without sacrifice of strength or power, is the primary engineering accomplishment in the new half-inch electric drill according to an announcement by the Independent Pneumatic Tool Company, 600 West Jackson Boulevard, Chicago. The new drill, known as the Thor U-44, weighs only nine pounds and is but twelve inches in overall length. It is a heavy-duty tool, designed for continuous service on production. At the same time, its light weight and small size give it the portability and carrying ease necessary for maintenance work.



Thor U44 portable drill

Because of its streamline design the Thor U-44 can be used in places formerly inaccessible for ½" drilling. It can be quickly converted into an accurate, sensitive drill press by mounting in a drill stand. The machine will drill a ½" hole 2" deep in one minute in steel when sufficient pressure is applied.

General specifications: Drilling capacity, ½"; free speed, 450 RPM; weight, 9 lbs.; length overall 12".

Neutral Wedge Photometer

The new Aminco Neutral Wedge photometer, an outgrowth of apparatus developed in the laboratories of the Food & Drug Administration of the U. S. Dept. of Agriculture, is announced by the American Instrument Co. of Silver Spring, Maryland. In the field of metals, it is applicable in the control and research laboratory.

This type of instrument has been used extensively there and elsewhere for the precise determination of micro and macro quantities of lead, arsenic, iron, phosphorous, vanadium and titanium. It can also be used for many other substances.

Since it can be equipped with optical color filters for isolating any narrow region of the visible spectrum, this instrument can be used for the determination of almost any substance that possesses, or produces in a reaction with another substance, a definite and reproducible color.

In the determination of micro quantities, usual chemical analytical methods are apt to be unreliable, whereas with the Aminco instrument, it is stated that quantities as small as 10^{-8} grams are easily detected and accurately measured. For example, in the analysis of lead by the dithizone method, it is possible to split the range 0 to 1 gamma into 20 parts. Precise and reproducible results are obtained in several minutes.

Complete details are contained in the manufacturer's Bulletin No. 1025MI, which is available on request.

Utility Test Panel

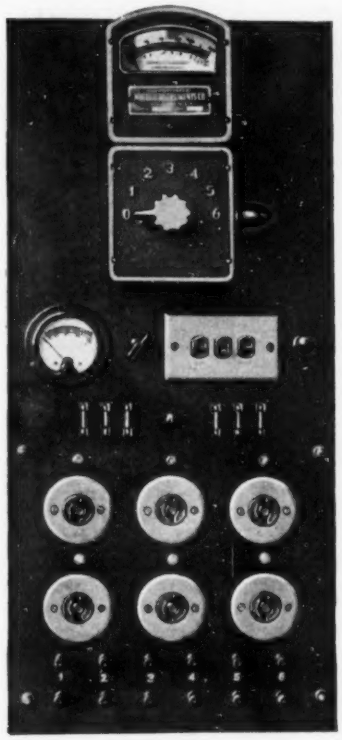
A small compact utility test panel has been designed for making routine and trouble tests on all electrical household, and portable appliances. Six separate devices may be put on test at one time, and a complete set of readings taken for each device separately, while they are on test.

The following tests can be made with this test panel:

The surface temperature or internal temperature of any device can be measured up to 800 degrees F.

The resistance of any device from 0 to 1000 ohms can be measured directly.

Continuity current readings can be observed on the milliameter as low as 10 milliamperes.



Wheelco utility test panel

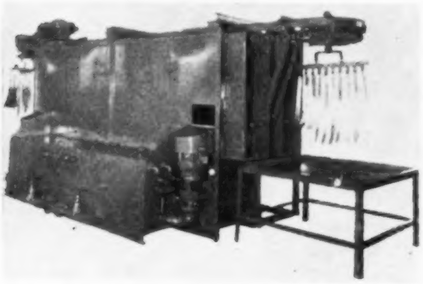
Test prods are provided to enable the user to check the resistance of any unit or any part of unit circuit; also to determine the resistance from element to ground on any device.

The operation of automatic thermostats may be observed visually.

Complete testing instructions and detailed operating description of each instrument knob and binding post mounted on the panel will be furnished upon request by writing to the Wheelco Instruments Company, 1929 South Halsted Street, Chicago, Illinois.

Washing Machine

A new washing machine developed by Metalwash Machinery Co., Inc., 117-19 E. 24th St., New York, is designed especially



Metalwash machine for cleaning metal parts

for the removal of polishing compound from steel knives, but it can be used equally well for racked work prior to plating or for cleaning other work after polishing.

This machine consists essentially of a hot alkali wash section, a hot rinse and a cold rinse. The work is then returned to the original loading point through a hot blast dryer so that if it is desired to wash, rinse and dry the work, only one operator is required. On the other hand it can also be used for washing and rinsing work, unloading it and passing it through subsequent operations and then hanging it back on the conveyor and passing it through the dryer to its original loading point. This design results in a highly flexible operating unit which is adapted to a wide variety of shop conditions.

The machine has, it is stated, also eliminated a fire hazard as it handles parts which were previously scrubbed by hand with kerosene or other inflammable solvents.

The machine is heated entirely by steam, gas or electric heat as desired.

Platinum and Gold Casting for Jewelry Purposes

A process has recently been developed by Thoger G. Jungersen of Canada, for the casting of platinum and gold jewelry.

The process is being offered to the jewelry manufacturers by Sigmund Cohn, 44 Gold Street, New York, who is the United States agent for the process. Mr. Cohn reports that remarkable results have been obtained since the process has been offered for sale, and it promises to be one of the important methods of manufacturing jewelry in the future.

The process is based on the well known French "cire perdu" process and consists in making a wax model of the object to be cast, setting it in a material similar to plaster of paris known as the investment, melting the wax from the investment and then casting metal into the mould thus made, and then breaking away the plaster from the casting. One of the most important and novel points in this process is the fact that it includes a most ingenious method of making the wax models accurately and rapidly. It will readily be seen that this is one of the most important steps involved in the process.

It is possible with this process to cast rings with considerable undercut, which is normally a very difficult if not impossible thing to do. This is brought about by the unique method of making the moulds in which the wax models are cast.

Another difficulty which had to be overcome in the process was the development of an investment capable of withstanding the extreme temperatures necessary for casting platinum. This presented a very serious problem and was one of the principal ones which had to be overcome before the process was ready for the market.

Manufacturers of jewelry, who have been using the process for some little time are said to have found it very economical and efficient. Castings of the most difficult and complicated nature, it is stated, are easily made, and the metal is sound, workable and susceptible of a good polish. The process is in general use in the East, Middle West and Far West.

It is understood that various patent applications cover different phases of the process and in the near future a rather strong patent position will be developed.

Molybdenum Wire, Rod and Sheet

Molybdenum, widely used for parts of electronic tubes and lamps, has been announced by the Westinghouse Electric & Manufacturing Company, E. Pittsburgh, Pa. in the forms of round wire and rod, and in sheets.

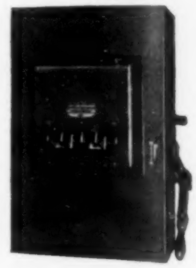
The wires and rods are from one thousandth of an inch to three-quarters of an inch in diameter. The sheets are up to several inches in width and from 2½ to 30 thousandths inch thick. This product is unique in its resistance to high temperatures, at the same time being workable with relative ease.

When used as heater winding on hydrogen furnaces it is entirely unattacked by the hydrogen, and its life is much longer than that of any other available material. It does not amalgamate with mercury to any great extent, making it valuable for use in mercury switches and in laboratory applications. It may also be used for sealing through the walls of glass vessels made of certain grades of hard glass.

Ductile molybdenum in sheet form is useful for "boats," or long boxes for treating material in high temperature hydrogen furnaces.

Window Type Safety Switch

That their Bulletin 4101 "Current Breaker" mill duty safety switch is available with a window in the cover to make inspection of the blade possible from the outside, is announced by Cutler-Hammer, Inc., manufacturers of electric apparatus, 401 N. 12th Street, Milwaukee, Wisconsin. This window is three-sixteenth inch shatter-proof glass held securely in place from the



Cutler Hammer Window Type Safety Switch

inside. A sponge rubber gasket is used to cushion the glass and seal the opening in the cover.

The window type line was developed to meet a demand for quick and safe inspection, and is available in standard sizes from 30 to 1200-amperes up to 600 volts, fusible and non-fusible.

Watch for the Coming Issues of Metal Industry!

The March and later issues of METAL INDUSTRY are scheduled to contain articles of vital interest to metal products manufacturing industries. We have definitely scheduled the following:

A Review of the New Equipment and Supplies for Metal Products Manufacturing, Plating and Finishing Developed in 1937.

Better Fire Protection for the Finishing Department, by Dr. Wm. H. Easton.

Polishing Technique for Stainless Steel, by C. C. Snyder and L. N. Kohl, Republic Steel Corporation.

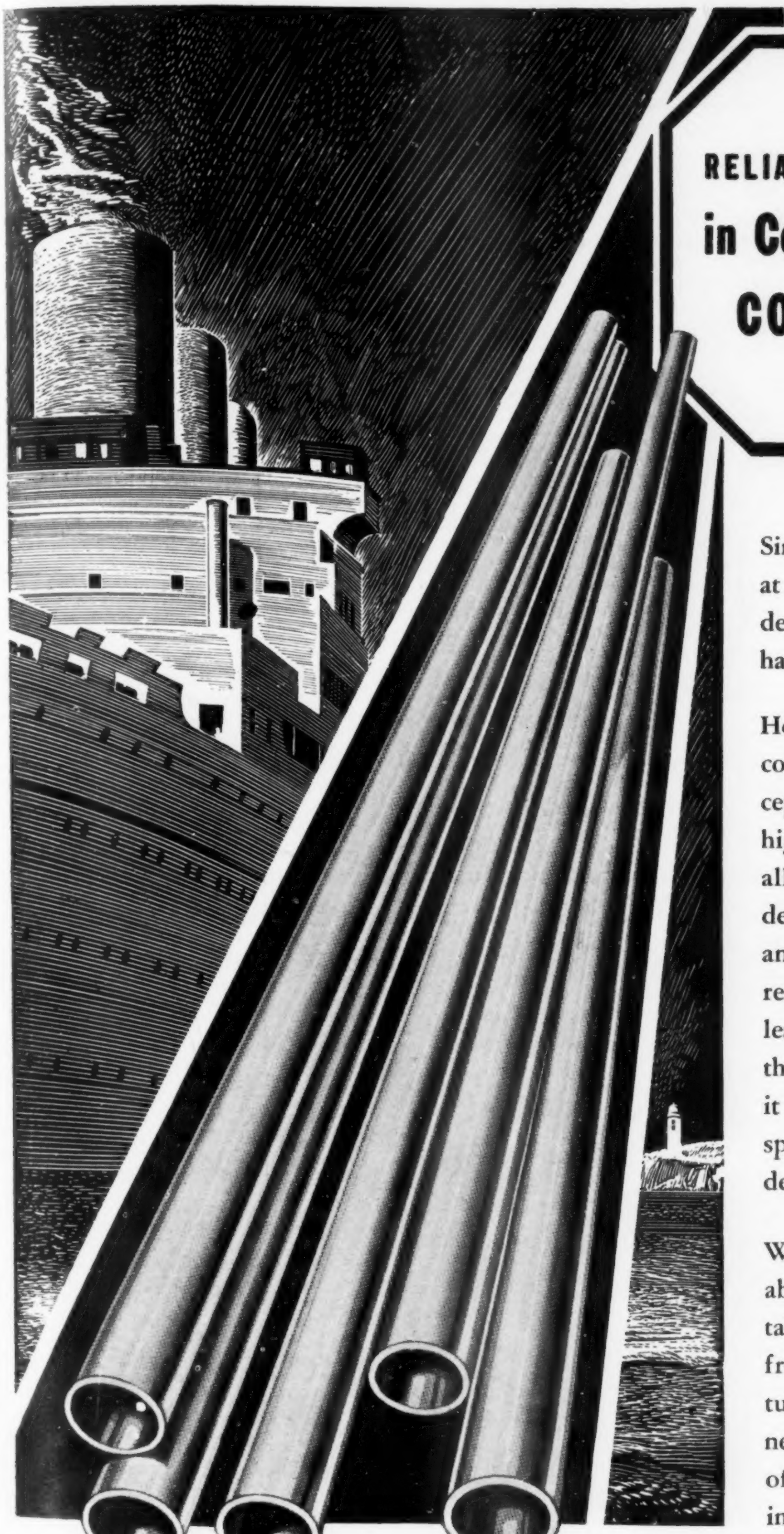
The Cost and Control of Polishing Supplies. How obtained and used for estimating and cost finding in the metal products manufacturing industry, by Chas. W. Hardy, Industrial Consultant.

Wastes in Metal Finishing Operations, by Philip J. Lo Presti, Electroplating Chemist.

Control of Electroplating Processes, by S. C. Taormina, Technical Director, Industrial Research Corp., Brooklyn, N. Y.

A Study of the Rochelle Salt-Copper Plating Bath. Part 5 of this important series by Dr. A. Kenneth Graham and Harold J. Read.

Watch for the Coming Issues of Metal Industry!



For

RELIABILITY AND LONG LIFE

in Condenser Tubes use COPPER-NICKEL ALLOYS

Since the early days of steam power at sea, the rapid corrosion of condenser tubes subjected to salt water has been a serious problem.

However, Copper-nickel alloys have come to the rescue. Due to their exceptional resistance to corrosion at high pressures and temperatures, these alloys have lengthened the life of condenser tubes, reduced overhaul costs and actually paid their own way. As a result the U. S. Navy and the world's leading commercial fleets as well as the navies of other nations now make it standard engineering practice to specify Copper-nickel alloys for condenser tubes.

With Copper-nickel alloy tubes available the ship owner need no longer take into account the possibility of frequently recurring expenditures on tube renewals, while the marine engineer can go to sea with the assurance of absolute reliability in his condensing plant.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 WALL STREET - - - NEW YORK, N. Y.

Associations and Societies

Boston Branch, A.E.S.

SECRETARY, A. W. GARRETT, 100 KING ST., DORCHESTER, MASS.

A Regional Research Conference was held by the Boston Branch of the American Electro-Platers' Society, at the Hotel Bradford on January 25, 1938. Sixty-two sat down to an excellent dinner.

The meeting was opened by *Bert Sage* who spoke briefly on the importance of distinguishing superior deposits from light deposits and the value of high grade work to the plating industry. He then turned over the meeting to *W. M. Phillips* of the General Motors Corporation.

Mr. Phillips pointed out some of the important recent developments in the plating industry, based on research. He mentioned the use of cadmium on steel automobile pistons and the use of chromium plating for rolls in steel mills. He was fully aware of the competition offered to plating by the newly developed plastics, but felt that the plastics would not hurt the plating industry, but rather help it. The combination of plated metals and plastics gave a very pleasing and attractive effect, which would increase the market for both materials.

Dr. William Blum of the National Bureau of Standards spoke on the value of research to the manufacturer. He pointed out the difference between research on fundamentals, such as polarization, crystal structure, etc. and industrial research on specific problems, new and improved methods, processes, etc. He showed how valuable and inexpensive the research work carried on by the Bureau of the plating industry, was. For example: the research on electroplating steel cost about $50,000. This amounts to just 5c each per car for one million cars. Needless to state more than 1,000,000 cars have been improved by the use of the tentative specifications developed by research described above, and needless to state also, the improvement in the plated parts was worth very much more than 5c per car.

G. B. Hogaboom of the Hanson-Van Winkle-Munning Company traced the history of electroplating, showing the value of research to the industry. He began with Faraday's first researches which resulted in the generator, and outlined the development of electroplating to the present day. A bright future for electroplating lies in the following directions.

1. Improved distribution of current for uniformity of deposit.
2. Use of higher current densities for more rapid plating.
3. Continuous tin plating by the steel mills, to replace hot tinning.
4. Continuous zinc plating by the steel mills to replace hot galvanizing.

The factors which will be most important in this work are (a) constant agitation, (b) continuous filtration; (c) control of temperature, possibly by refrigeration.

The future of electroplating is more promising than it has ever been.

W. J. R. Kennedy, secretary of the A.E.S. made a plea for contributions (or in the words of Mr. Phillips, "investments") to the Research Fund.

Announcement was made of the coming Annual Banquet and Educational Session of the Boston Branch on February 26, at the Bradford Hotel. A very fine educational program has been arranged and also the best entertainment procurable. All members and others interested in electroplating are cordially invited.

Chicago Branch, A. E. S.

SECRETARY, JAMES HANLON, 3004 N. WHIPPLE ST., CHICAGO, ILL.

The Chicago Branch held its 26th Annual Banquet and Educational Session at the Palmer House, Saturday, January 15th. *Oscar Servis* presided over a meeting with 300 present at the educational session.

The first speaker was *A. B. Wilson*, president of the A.E.S., who made a strong speech asking for increased activity and interest of the members.

Papers presented at the session were as follows:

pH and Electrode Reactions. E. H. Lyon, Jr., Meaker Co.

Alkaline Cleaners and Wetting Agents. F. K. Savage, C. G. Conn Ltd.

A Review of Bright Nickel Processing in Commercial Use, Trouble encountered and

proof derived in using bright nickel. O. J. Sizelove, F. Gumm Chemical Co.

The Purification of Plating Solutions by Electrolysis. V. Mattacotti, Hanson - Van Winkle-Munning Co.

Coloring of Cadmium. W. J. Erskine, National Lock Co.

The Banquet which was held at 7, was successful beyond all expectations. Over 700 tickets were sold. The entertainment was amusing and enjoyable and the assembled diners enjoyed themselves hugely between an excellent dinner, entertainment and dancing between courses.

Congratulations to the Chicago Branch!

Institute of Metals Division

29 W. 39TH ST., NEW YORK.

Institute of Metal Division, A.I.M.E., will hold its annual winter meeting February 14-17, 1938, at the Engineering Societies Building, 29 W. 39th Street, New York.

The program will include the following papers:

Creep and Fracture Tests on Single Crystals of Lead, by John B. Baker, Prot. Drexel Institute; Bernard B. Betty, International Nickel Co. Inc., and H. F. Moore, Prof. University of Illinois.

Indium-treated Bearing Metals, by C. F. Smart, Metallurgist, Pontiac Motors Div., General Motors Corporation.

Calcium Metallurgy, by C. L. Mantell, Consulting Chemical Engineer, and Charles Hardy, President, Charles Hardy, Inc.

Powder Metallurgy Symposium I (Joint Session with Iron and Steel Division).

Powder Metallurgy, Its Origin and Development, by Charles Hardy, President, Charles Hardy, Inc.

Production and Some Testing Methods of Metal Powders, by D. O. Noel, J. D. Shaw and E. B. Gebert, Metals Disintegrating Co.

Types of Metal Powder Products—a Classification, by Gregory J. Comstock, Handy & Harman.

Ductile Tantalum, Columbium and Molybdenum, by C. W. Balke, Fansteel Metallurgical Corporation.

Powder Metallurgy Symposium II (Joint Session with Iron and Steel Division).

The Properties of the Platinum Metals: II. Tensile Strength of Platinum and Platinum Metal Alloys at Elevated Temperatures, by E. M. Wise, Metallurgist and J. T. Eash, Metallurgist, Research Laboratory, International Nickel Company.

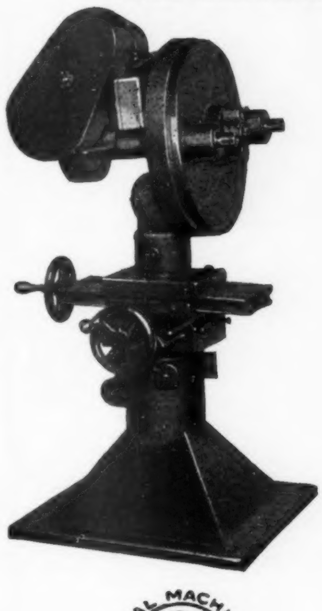
Strain Transformation in Metastable Beta Copper-zinc and Beta Copper-tin, by Alden B. Greninger and Victor G. Mooradian, Instructors in Metallurgy, Harvard University.

Deformation of Beta Brass, by Alden B. Greninger, Instructor in Metallurgy, Harvard University.

An Investigation of Wire Bars of Electrolytic Copper, by Michael G. Corson, Consulting Metallurgist.

Rates of Diffusion in the Alpha Solid Solutions of Copper, by Frederick N. Rhines, Asst. Prof. Metallurgy, and R. F. Mehl, Director Metals Research Lab., Carnegie Institute of Technology.

The Solubility of Lead and Bismuth in Liquid Aluminum and Aluminum-Copper Alloys, by L. W. Kempf, Metallurgist and K. R. Van Horn, Research Metallurgist, Aluminum Research Lab., Aluminum Co. of America.



Personals

D. W. Robinson

D. W. Robinson, for more than fifty-two years actively engaged in electro-plating as Foreman and Supervisor of polishing, buffing and finishing of a great variety of metal goods, and for the past twenty-seven years, supervisor of all such work for Remington-Rand Typewriter Company at Ilion, N. Y., retired Jan. 1, 1938 from active service on account of failing health.

Mr. Robinson's ability to produce finely finished work and to use available equipment to the best advantage, together with his understanding of human nature and its application in handling and training men, gave him high standing with employer and employee.

When eighteen years of age, a country boy, he secured work as a clerk, first in a large hardware company office, and later with the New York, New Haven and Hart-

D. W. ROBINSON

ford Railway Co. at New Haven, Conn. After putting in some time in this way, a glimpse through an open door of a small plating shop one day drew his attention as he was walking along the street and he became interested in plating and finishing.

During subsequent years he was employed by some twelve different concerns in Connecticut and Pennsylvania. His first experience in typewriter work was at Bridgeport, Conn. in 1899 with the Union Typewriter Co., this factory afterward becoming a Remington plant. He continued from then until the present, in typewriter finishing.

Wesley F. Hall

They say that no man is a hero to his valet. By the same token, it is equally difficult for a man to be a hero to his associates. However, Wesley F. Hall of the Hanson-Van Winkle-Munning Company, Matawan, N. J., manufacturers of electroplating equipment and supplies, (whose article on zipper plating appears on page 74 of this issue) is a prominent exception to this rule. He is known in his Company as "the crazy inventor" who has done more than anyone living for the development of automatic machinery in the electroplating industry.

Mr. Hall's first experience in industry was in the shoe machinery field. Later he pioneered in marine gasoline engine design. He then went with the old Munning and Loeb Company (which later became the A. M. Munning Co., and afterward merged with the Hanson and Van Winkle Co., to become the Hanson-Van Winkle-Munning Company) first as a designing engineer. An early job was the design of the Optimus plating barrel. Then he acted as superintendent of the plant. When the merger took place in 1927 he was designated Chief Designing Engineer. One of his outstanding designs was the standard full automatic plating conveyor.

Mr. Hall is known in his Company as "the brains of the mechanical department."

WESLEY F. HALL

However, he has one great defect. He cannot be dragged into the lime-light. It took a Herculean effort to get him here!

Electroplating Equipment Manufacturer, the New Lord Mayor of Birmingham

Councillor E. R. Canning J.P. was elected Lord Mayor of Birmingham, England, on November 9th, 1937.

A native of Binton, in Warwickshire, Mr. Canning is 61 years of age. He came to Birmingham at the age of 10 and was educated at King Edward Grammar School, Aston. Taken into partnership by his elder brother, T. R. Canning, in 1902, on the retirement of the latter in 1918 he became the sole proprietor of W. Canning and Co. Two years later it was turned into a limited company, with himself as chairman and managing director. The business, under various owners, has been in existence nearly 150 years, and 50 years ago it was one of the pioneers of nickel plating.

Photo by Wynne.

E. R. CANNING

Nearly 40 years ago Mr. Canning came under the personal influence of Mr. Joseph Chamberlain. On the resignation of Sir Samuel Talbot, he became chairman of the West Birmingham Unionist Association in 1925, and later succeeded Sir Francis Pepper as Hon. Secretary of the Birmingham Unionist Association.

He entered the Council for St. Paul's Ward in 1930, and has been the city "Chancellor of the Exchequer" for three years. Other committees of which he is a member include the General Purposes, Rating and Valuation, and Salaries and Wages and Labour. He was made a J.P. in 1929.

Mr. Canning is a man of wide sympathies and unbounded energy. He is chairman of the Commission that reported on the position of the Anglican Church in Birmingham, and when the Bishop launched his appeal for 100,000 guineas Mr. Canning was appointed one of the vice-chairmen. He is a manager of St. Paul's Church of England School, a member of the Cathedral Council, life governor of the Birmingham University, governor of King Edward's Foundation, Chairman of the Birmingham Playing Fields Association, hon. treasurer of the Birmingham District Association of Boy Scouts (he is himself a Rover Scout), a member of the Executive Committee of the Federation of British Industries (West Midland area), and is a patron of the West Birmingham branch of the British Legion.

An active sportsman, he plays golf, swims, shoots and is a keen angler. His silver wedding was celebrated in 1934.

Mrs. Canning belongs to an old Somerset family. For many years, she was Commissioner for the All-Saints' district of the Girl Guides. She is the vice-president of the Handsworth District Nursing Association, a member of the Women's Hospital Committee, and a patroness of the women's section of the West Birmingham British Legion.

Dr. Foster D. Snell addressed the Baltimore Section of the American Chemical Society on January 25th on the subject "Some Factors in Detergency." In his talk Dr. Snell outlined the four known factors and presented evidence to indicate that only those factors control the efficiency of a detergent. This was then applied to many types to illustrate variation in the relative importance of different factors in the cases of toilet soaps, laundry detergents, scrub soaps, wetting out agents, sulfated alcohols, etc.

William M. Phillips, Engineer of Finishes of the General Motors Corporation, Detroit, Mich., will present a projectoscope talk entitled "Graphic Presentation of Electroplating Operations," at a meeting of the American Section of the Society of Chemical Industry on February 11, 1938, at 8:00 P.M. at The Chemists' Club, 52 East 41st Street, New York City. This is to be held jointly with the American Chemical Society. A dinner will be held at the Club, preceding the meeting and starting at 6:15 P.M.

Robert L. Hamilton has been named sales manager of the Dumore Company, Racine, Wis., effective January 1st, 1938. In his new capacity Mr. Hamilton will fill the vacancy caused by the resignation of *Leland B. Augustine,* who has been sales manager for several years past. Mr. Augustine will now take personal charge of Dumore sales in the Chicago territory.

Abbott F. Riehle has been appointed sales manager of the Smootharc Welder and Welding Electrode Division of the Harnischfeger Corp., Milwaukee, Wis.

Joseph A. Messenger, formerly of United Engineers & Constructors, Inc., has been appointed general manager of the Buell Engineering Company, Inc., 70 Pine Street, New York City. The Company, a subsidiary of the American Goldfields Development Company, is engaged in the manufacture of fly-ash eliminators, dust collecting systems and turbo dryers for all industries.

E. F. Smith has been promoted to the place of District Sales Manager for Michigan, Northern Ohio and Eastern Pennsylvania for the Chicago Vitreous Enamel Product Company of Cicero, Illinois. Mr. Smith has been with Chicago Vitreous in sales and service capacity for five years. He was formerly associated with the Renown Stove Company, Owosso, Michigan, as enamel plant superintendent.

E. C. Greenstreet, formerly with Standard Gas Equipment Company of Baltimore, and active in the management of the Eastern Enamelers Club, has recently resigned to become affiliated with the Chicago Vitreous Enamel Product Company of Cicero, Illinois.

Albert Hirsch, a member of A.E.S. Research Committee, has joined the organization of Synder, Inc., automotive and radio specialties manufacturers, located at Noble & Darien Sts., Philadelphia, Pa., where electroplating "Significant Surfaces" for thickness of coating is a specialty.

Obituaries

John A. Capp

John A. Capp, engineer of materials in the General Electric Works Laboratory at Schenectady, died January 6 after a short illness. He would have been 68 years of age on January 14 and had served more than 45 years with the Company.

Mr. Capp was born in Philadelphia in 1870 and as a student at Central High School there he was a pupil of the late Professor Elihu Thomson, with whom he was later associated in the Thomson-Houston Company, a predecessor of the General Electric Company, at Lynn, Mass. Mr. Capp was graduated from the University of Pennsylvania in 1891 and after a short time at Lynn, was sent to Schenectady. He formed the testing laboratory and was its head until it was merged with the Schenectady Works Laboratory in 1927.

As a charter member of the American Society for Testing Materials he has been active in its work since 1898. He was president in 1918 and 1919, and last year was elected an honorary member of the organization. He was instrumental in the formation of the American Standards Association, and for many years represented the ASTM with the standards group.

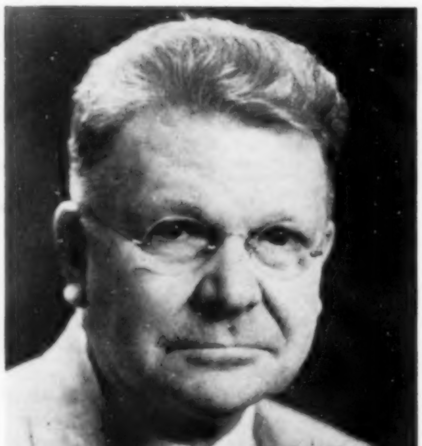
Mr. Capp was a member of the American Foundrymen's Association and for many years was active in the American Society for Metals.

Augustus Ernest Kayes

The untimely death of A. E. Kayes, Superintendent of the Refining and Calcining Departments of the Huntington Works of The International Nickel Company, Inc., on November 5, 1937, at the age of 54 years, has removed one of the foremost metallurgists from the non-ferrous alloys industry. Mr. Kayes was born in New York City February 26, 1883, the only son, and the second of five children, of Augustus and Wilhelmina Kayes, who had come to the United States from Basle, Switzerland, the previous year. Mr. Kayes lived his youth in New York City and was educated in its public schools, Stuyvesant High School, and Cooper Union.

Mr. Kayes joined The International Nickel Company, Inc. at its Orford Works, Bayonne, New Jersey, March 6, 1905. Except for a brief period in 1922, he remained continuously in the service of this organization and by his enthusiastic and energetic efforts gained for himself the highest regard and esteem of all of his associates.

Mr. Kayes was successful in developing and perfecting electric furnace technique for Monel and other copper-nickel alloys, and he was the first to produce the low carbon, iron-nickel, high permeability magnetic alloys on a commercial scale in an electric arc furnace. The practical aspects of the melting and



JOHN A. CAPP

AUGUSTUS ERNEST KAYES

refining of chromium-nickel and chromium-iron-nickel alloys, and depolarized nickel for anode uses were also worked out under his direct supervision. He personally refined, or supervised the refining of, more than a half million tons of nickel alloys and pure nickel in malleable forms. His more important discoveries and improvements have been protected by more than twenty domestic and foreign patents throughout the world.

In 1932 he was one of the founders of the Electric Metal Makers Guild, the membership of which is comprised entirely of specialists engaged in the melting of metals and alloys in electric furnaces. He was elected the second President of this organization and was most active in it at all times.

Mr. Kayes was, in every sense, an able pioneer. He helped to lead the progress and growth of the industrial applications of nickel and its alloys through nearly two generations. He was a friend of many, modest, and always eager and willing to help younger men.

He was greatly beloved by his associates. They will always remember "Gus" with the deepest affection and profoundest respect. They will miss his friendly smile, his sound advice, his enthusiasm, his willing assistance and his keen sense of fair play. They will always be grateful for the splendid organization which he trained and which he has left to carry on his life's work.

Mr. Kayes was married to Katherine Bakewell on February 18, 1904. Two children, Frederick Gibson Kayes of Huntington, West Virginia, and Mrs. William T. Lambert of Columbia, Tennessee; his mother, Mrs. Wilhelmina Kayes of New York City; and three sisters, Mrs. G. P. Minckler and Mrs. F. L. Huxtable of New York City, and Mrs. Frank Weems ot Sausalito, California, survive him.

C. H. Champlain

C. H. Champlain, died December 2nd. Mr. Champlain was formerly works manager of the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. He had retired in 1934 after 36 years with the company, having begun as an assistant foreman.

Thomas W. Haddow

Thomas W. Haddow, 34, of Pompton Plains, New Jersey, assistant to the sales manager of Maas & Waldstein Company, industrial finish manufacturers, Newark, New Jersey, was killed in his own home on January 19th, by the accidental discharge of a rifle he was cleaning.

Mr. Haddow had a wide circle of friends in the electro-plating and metal finishing industries. He began his life work in the electro-plating field, and joined the Maas & Waldstein organization in 1925. He is survived by his wife and an infant daughter. His father, Thomas B. Haddow, is one of the founders of the American Electro-Platers' Society.

Verified Business Items

Wheelco Instruments Company, 1933 South Halsted Street, Chicago, Illinois, has recently appointed three new representatives to handle the sales and service of Wheelco temperature control, indicating, and safety instruments in their respective areas. *C. I. Gillen*, 5026 Osage Ave., Philadelphia, Pa.; *H. F. Rehling*, 993 South Street, Boston, Mass.; *R. W. Coward*, 2400 Arlington Ave., S., Birmingham, Ala.

Cowan Manufacturing Company, 116 Mendota Street, North Side, Pittsburgh, Pa., has achieved a considerable reputation in Western Pennsylvania as a plating shop, capable of doing a wide variety of work. According to an extended report in the Pittsburgh Press, their service includes everything from the refinishing of antiques and art objects to production work on bolts, nuts, hardware and other commercial quantity products. The finishes which they apply include chromium, cadmium, copper, nickel, zinc, brass, tin, silver, gold and rhodium. They also do acid dipping and metal coloring. This company was formed in 1908 and incorporated in 1920. *Herbert F. Saylor* is president, *Leo. J. Schmitt*, secretary-treasurer.

Commencing the celebration of its Golden Anniversary the *Diehl Manufacturing Company*, Elizabethport, New Jersey, held a general sales conference at the Elizabethport Plant, starting Thursday, January 6th and continuing until Tuesday, January 11th. The conference was called by *Frank B. Williams, Jr.*, Vice President and Sales Manager to discuss plans for the sales promotion and advertising of the Company's many electrical products.

Cutler-Hammer, Inc., of Milwaukee, Wisconsin, as part of its foreign trade activities announces that a company known as *Canadian Cutler-Hammer Limited* has been organized for the purpose of manufacturing Cutler-Hammer motor and generator control products for the Canadian market. The Company will be a subsidiary of the *Amalgamated Electric Corporation Limited* which will provide the manufacturing facilities.

The new Company's headquarters address will be 384 Pape Avenue, Toronto 6, Canada.

"Finishes engineered to the job" were exhibited by *Maas & Waldstein Company*, makers of industrial finishes, 438 Riverside Ave., Newark, New Jersey, at the International Heating and Ventilating Exposition, held in New York in January. The exhibit included air-conditioning units, oil heater jackets, and oil burners finished in M & W finishes specially designed to withstand the service conditions to which each of these products is subjected. Stress was laid on the parts played by good design, color, quality of finish, and wearing qualities in increasing manufacturers' sales. *B. D. Sanderson*, sales manager of the company, was in charge of the M & W booth.

To handle sales and servicing of their extensive line of precision gauging tools, *Carl Zeiss Inc.*, 485-5th Ave., New York, announces the appointment of the following district representatives: *Sid Langston*, 1213 West Third St., Cleveland, Ohio; The *C. H. Gosiger Machinery Company*, Bacon and McDonough Streets, Dayton, Ohio; *Edward W. Voss*, 2882 East Liberty Avenue, Pittsburgh, Penna.; *Higgins & Linde, Inc.*, 564 West Randolph St., Chicago, Ill.; *W. A. Kerr*, 54 Chilton Street, Belmont, Mass.

Selection of Monel storage tanks for a newly designed line of Ruud automatic gas water heaters was announced by *A. P. Brill*, president of the *Ruud Manufacturing Company* at the annual meeting of the Company's Regional Managers in the United States and Canada in the Hotel Schenley, Pittsburgh, Pa.

Muskin Mfg. Company, 61 Washington St., Brooklyn, N. Y., manufacturer of metal goods, has leased three floors in six-story building at 104 Ashland Place, for expansion. Departments: tool room, cutting-up shop, stamping, lacquering and enameling. The firm is interested in painting equipment.

Worcester Brass & Electroplating Company, 316 Shrewsbury St., Worcester, Mass., has filed plans for a steam power house, for which general contract was let recently. Departments: zincing (galvanizing), metal spraying, polishing and buffing, electroplating, lacquering and enameling.

Parker-Wolverine Co., Detroit, Mich., have voted to acquire the assets of the *Modern Stamping & Mfg. Co.* of Detroit, through an exchange of stock. The latter company has been a supplier of metal stampings to the former. The firm operates a stamping department.

Tuthill Spring Co., 760 Polk St., Chicago, Ill., announces a new division of the company known as the Metallizing Division. Departments: stamping, metal spraying.

Lincoln Park Tool & Gage Co., Lincoln Park, Mich., announces that it is now operating a department devoted exclusively to hard chrome-plating which has been installed in a new addition to the plant. The new plating department, which is operated under the license and engineering service provided by United Chromium Co., will be equipped to plate work ranging from a 1/16-inch diameter hole to a bar 5 feet long.

Geoffrey R. Bennett has been made general manager of Toledo Scale Co., Toledo, O., taking over the active supervision of sales and finance in addition to his former supervision of engineering and manufacturing. *Hubert D. Bennett*, his brother, remains as president. The firm operates the following departments: tool room, stamping, grinding, polishing and buffing, electroplating, lacquering and japanning.

The *Chain Belt Co.*, Milwaukee, Wisc., recently built a new addition to their W. Milwaukee works. The latest edition of their house organ Rex World Vol. 3 No. 2, contains a number of interesting photographs showing the operations performed in their plant in the manufacture of chains, belts and conveyors.

Lea Manufacturing Co., Waterbury, Conn., has been appointed by *General Abrasive Co. Inc.*, Niagara Falls, N. Y., as its exclusive representative in Connecticut and Western Massachusetts for handling the sale of Lionite polishing grains. Complete stocks of all sizes will be carried in their warehouse at Waterbury.

Koppers Company, Pittsburgh, Pa., announces that it has acquired exclusive rights to the manufacture and sale of the line of valves and other waterworks and sewage equipment formerly produced by the *Michigan Valve and Foundry Division* of the *Timken-Detroit Axle Company*.

Production of the line will not be interrupted. It will be produced under its present trade name by Koppers Company's Western Gas Division, Fort Wayne, Ind., and will be added to its "Western" line of valves, sluice gates and similar equipment, according to *R. A. Wickes*, general manager of the division.

Leo A. Behrendt, Vice-President of the American Crucible Company at Shelton, Connecticut, has been elected President of the Crucible Manufacturers Association.

Warren McArthur Corp., 1 Park Ave., New York, manufacturer of aluminum and other metal furniture with main plant at Rome, N. Y., has purchased former plant of Bantam Ball Bearing Co., Bantam, Conn., comprising one-story structure of about 40,000 sq. ft. floor space, and will remodel for new works.

Hammond Machinery Builders, Inc., Kalamazoo, Mich., have moved their New York office from 148 W. 23rd St., to 71 W. 23rd St., with increased space and display of equipment. *W. J. Holtmeier* is Eastern manager. This office takes care of Metropolitan area, New England, New York State, Eastern Pennsylvania, Delaware, Virginia, Maryland and North Carolina.

Wilfred S. McKeon, president, Sulphur Products Co., Greensburg, Pa., was one of a group of "small" business men invited to call upon President Roosevelt recently to discuss business conditions.

Metals and Metal Finishes Aboard Ship

***By* M. W. SCHWARZ**
Chemical Engineer

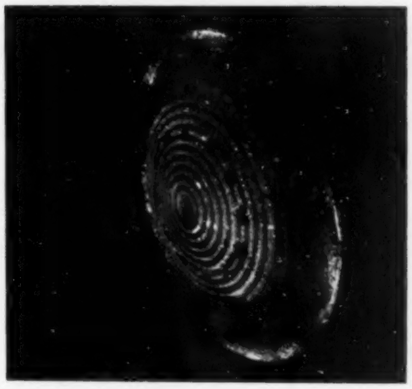
The thirty-third Annual National Motor Boat Show was held at Grand Central Palace, New York City, January 7-15, 1938. Always a hit with the general public, the Show offered a large proportion of exhibits, of particular interest to the metal industry.

One of the first impressions, after looking over the fleet on the main floor, was the general use of chromium plated fittings and hardware. The yellow brasswork, formerly so much in evidence on shipboard, is no longer used to any extent on motor boats. For the exterior parts, such as searchlight, running lights, horn, ventilators, cleats, stanchions and trim, bright chrome plate on brass or bronze has been adapted by nearly all manufacturers; satin finished chrome is used extensively for interior parts. To withstand the severely corrosive conditions to which marine metalwork is subjected, a first class plating job is essential. *The Rostand Manufacturing Company*, Milford, Conn., in the production of all their chrome plate on brass or bronze, first electroplates in an acid copper solution for 1 to 1½ hours. The work is then polished, nickel plated for 1 to 1½ hours, and polished again. Chromium plating for 3 to 5 minutes is followed by a final polishing operation.

Included among the non-ferrous alloys most widely used in motor boat construction, are Monel metal and Tobin bronze for shafts, manganese bronze for propellers and rudders, and Everdur (copper-silicon alloy) for bolts and other parts. Monel metal is also used for galley trim. Water tanks are hot dip galvanized, and fuel tanks are made of terne plate.

Die castings occupy an important place in the outboard motor field. For this service, aluminum alloys, which are said to be resistant to salt water corrosion, and of increased strength and toughness, are now employed.

The *Portable Light Company, Inc.*, New York City, employs rhodium in the construction of parabolic reflectors for their 13 inch and 20 inch diameter searchlights; these lights are intended for use aboard freighters, tankers and other commercial vessels. The reflectors are made under the *Bart Process*, which consists of depositing rhodium on glass, and backing the rhodium with approximately one eighth inch of electrodeposited copper.



Marine Electrolysis Eliminator installed on the yacht "All Alone"

Corrosion of hulls, condensers and engines, due to electrolysis, is often a serious problem. *Smith-Meeker Engineering Company*, New York City, offers Marine Electrolysis Eliminators as protection against this destructive force. The Eliminator is in the form of a corrugated plate, and is made of a zinc alloy, which is said to remain free from oxide coating during use. The manufacturers state that as the Eliminator is corroded instead of the steel hull, the

hull paint remains intact, and prevents the usual marine growths, such as barnacles, coral and oysters.

Among the recent developments in the motor boat field that may be expected to benefit the metal industry, are the increasing use of refrigerators, fresh water cooling systems and vapor detectors.

Following is a list of exhibitors, who employ metals, alloys and metal finishes in the manufacture of their products.

American Brass Co., Waterbury, Conn.
Baltimore Copper Paint Co., New York.
Bausch & Lomb Optical Co., Rochester, N. Y.
Bendix Marine Products Co. Inc., South Bend, Ind.
Columbian Bronze Corp., Freeport, L. I.
T. E. Conklin Brass & Copper Co., N. Y.
C-O-Two Fire Equipment Co., Newark, N. J.
Delco Products, New York.
Joseph Dixon Crucible Co., Jersey City.
E. I. duPont de Nemours & Co. Inc., Wilmington, Dela.
Eclipse Aviation Corp., E. Orange, N. J.
Eclipse Machine Co., E. Orange, N. J.
Electric Storage Battery Co., Phila., Pa.
Federal-Mogul Corp., Detroit, Mich.
General Alloys Co., Boston, Mass.
Harrison Radiator Div., Lockport, N. Y.
Hyde Windlass Co., Bath, Maine.
Ideal Windlass Co., Boston, Mass.
International Nickel Co., Inc., New York.
Walter Kidde & Co. Inc., New York.
L. O. Koven & Brother, Inc., Jersey City.
Lux Fire Extinguishing Systems, N. Y.
Marblehead Boat Corp., Biddeford, Maine.
Maxim Silencer Co., Hartford, Conn.
Michigan Wheel Corp., Grand Rapids, Mich.
M. L. Oberdorder Brass Co., Syracuse, N. Y.
Perkins Marine Lamp & Hdwe. Corp., Brooklyn, N. Y.
The Portable Light Co. Inc., New York.
Pyrene Mfg. Co., Newark, N. J.
The Rajah Co., Bloomfield, N. J.
Rostand Mfg. Co., Milford, Conn.
Sandvik Saw & Tool Corp., New York.
Scientilla Magneto Co., South Bend, Ind.
Wheeler-Schebler Carburetor Co., Flint, Mich.
The Sherwin-Williams Co., New York.
Simplicity Boat Hoist Co., Paterson, N. J.
Smith-Meeker Engineering Co., New York.
Stewart-Warner Corp., Chicago, Ill.
W. & J. Tiebout, New York.
United American Bosch Corp., Springfield, Mass.
Western Electric Co., New York.
Wilcox, Crittenden & Co. Inc., Middletown, Conn.
Zenith Carburetor Co., South Bend, Ind.

Industrial Uses for Silver*

In Technical News Bulletin 244 (August 1937) appeared an outline of the research program sponsored by a group of leading American silver producers to develop new industrial uses for silver.

Since appointment of the last of the 15 research fellowships at the various laboratories engaged in this investigation about the first of June 1937, an active study has been made along the various lines mapped out in the earlier report on this product. Definite progress has been made in each field studied, and, in several instances, indications are that the particular researches will, when completed, be of considerable interest to industry.

Silver in Bearings

At one institution a Silver Research Project Fellow has been investigating the anti-friction properties of silver and silver-rich alloys. Amsler wear tests evaluate the load which produces a given coefficient of friction and give information regarding the tendency of the alloy to gall and score a steel journal. The effect on the antifriction qualities of a great many elements added to pure silver has been determined. Pure silver has been found exceptionally qualified for use as a bearing material, most alloy additions producing inferior results. The data being obtained are of special interest because steel-backed bearings lined with nearly pure silver have come into commercial use within the year, being standard equipment on certain aviation engines. Because of the resistance silver offers against galling and scoring, it is being considered

*From the Technical News Bulletin of the National Bureau of Standards, Washington, D. C.

for shims and metallic packing. The latter application takes advantage, also, of the resistance of silver to heat and corrosion.

Electrodeposition of Silver

Two research investigators studying the electrodeposition of silver and of silver alloys have developed methods for obtaining adherent deposits on steel and for codeposition of a number of elements with silver. The development of further improvements in electroplating technique is expected to extend materially the usefulness of silver plating in the chemical and other industries.

Silver for Electrical Contacts

The study of silver slip rings and silver-graphite brushes for rotating electrical contacts has demonstrated marked advantages for these materials over carbon or copper-graphite brushes, and copper slip rings or commutators. Contact voltage drop is very much less, operation follows the Ohm's law relationship closely, and much higher current densities can be tolerated. Furthermore, there is much less polarity effect when using the silver contacting surface. Manufacturers of electrical equipment have already taken cognizance of these test results, which may lead to improved design in certain electrical equipment.

Silver in Engineering Alloys

The effect of additions of silver in small amounts (up to about 5 per cent) to the engineering alloys is being studied on a comprehensive scale through cooperation of five men working at three different institutions. These same research workers are also noting the effect of small additions of other metals to pure silver. In general, the response to various annealing and hardening treatments and to corrosion is being studied. It is expected that data will also be obtained on castability, mechanical properties, electrical conductivity, and other properties likely to be of special interest. Almost 200 alloys have been prepared for this work.

Special attention is being devoted to the lead-silver solders containing from about 2 to 6 per cent of silver, with and without other additions, as competitors with the lead-tin solders and as intermediate temperature solders. Long-time creep-test data are being obtained on soldered joints made with such alloys, at both room and elevated temperatures.

Another investigation sponsored by this project has to do with the effect of silver additions to storage-battery grids.

Technical data are being gathered on all silver-alloy systems, the patent literature dealing with silver, and the use of silver in the chemical industry.

A. J. Dornblatt, senior research associate at the National Bureau of Standards, representing the American Silver Producers, has recently visited some 60 companies and research laboratories to acquaint them with the objectives of the various researches, and the results being obtained on this project, and to solicit suggestions and data from their staffs. Parties interested in any phase of the American Silver Producers' cooperative research are invited to correspond with the Bureau for details.

Electroplating Course by Correspondence

A complete course on electroplating is now available to students outside the New York area. This consists of all necessary chemicals, glassware, apparatus, books, paper, analytical balance (sensitive to 1/10 milligram), weights, and twelve lessons. On receiving the first course the student studies the lecture notes, performs the indicated experiments and writes all the data on paper provided with the course. All lessons are corrected and filed by the student in a special loose leaf notebook provided with the course. The lecture notes are devoted to a theoretical consideration of electroplating while the laboratory exercises help the student apply these principles. Copper, nickel, zinc, cadmium, chromium, silver and brass are deposited from aqueous solutions, aluminum is anodized and colored. While plating the above metals the factors governing the character of the deposit are noted by the student.

During the deposition of these metals, Faraday's laws, addition agents, throwing power, and hydrogen ion concentration, are studied. The effect of temperature, current density, impurities, are also noted. Other experiments include the study of thickness of deposits, electrical resistance of plating solutions, current efficiencies, etc.

After the above have been completed, the student now makes up his own standard analytical reagents (using the analytical balance) and analyzes all plating solutions made for their constituents.

For further information write to Dr. C. B. F. Young, Box 292, Flushing, L. I., N. Y.

Metal Industry Not Connected with Metals and Plastics Bureau

In response to a number of inquires, METAL INDUSTRY makes publicly, the following statement:

METAL INDUSTRY has never had any connection with Metals and Plastics Bureau, formerly known as Metal Products Exhibits, located in International Bldg., Rockefeller Center, New York, nor are we at this time connected with that organization, officially or unofficially.

Any misunderstanding which may have become current was probably due to the fact that METAL INDUSTRY like a number of electroplating equipment and supply houses, took space with the Metals & Plastics Bureau during the last Annual Convention of the American Electro-Platers' Society which was held in New York, June 14-17, 1937.

Aluminum Company Plans Continued Operation

The current recession in business can be more quickly stemmed if both industry and government will state what they are going to do about it, declared *Roy A. Hunt*, president of *Aluminum Company of America*, Pittsburgh, Pa., as he outlined what his company is doing to keep up production in its plants producing aluminum ingot despite a falling off of demand. Mr. Hunt said:

"Frank statements of policy by industry can have a most beneficial effect on the welfare of the country and much good can result if American industry and government will make known their intentions.

"Speaking for our company, despite a falling off in orders in the past three months of more than 60 per cent, the Aluminum Company of America has not curtailed its production of ingot. The company is doing its part by maintaining a steady program of production of aluminum ingot even though demand for aluminum products is curtailed and there is a dearth of orders from its thousands of customers. In the lean years after 1929, the Aluminum Company of America followed this general policy, maintaining production greatly in excess of shipments until it had accumulated a stock of more than 300,000,000 pounds of aluminum—literally acres of it.

"When other prices were rising rapidly last spring, the Aluminum Company announced April 8 that its policy would be to maintain its prices for the balance of the year. The company believes that all users of aluminum and the public in general benefited by this policy. The price of aluminum ingot in 1926 was 27 and 28 cents per pound, in 1929 it was 24.3 cents per pound, while today the price is 20 cents per pound.

"Also on April 8 of last year the company announced a $26,000,000 expansion program, which it is continuing in spite of the present recession."

Manning, Maxwell & Moore, Inc., Fights Recession with 25% Increase in Sales Force

In contrast with the policy of other companies in reducing their sales forces, Manning, Maxwell & Moore, Inc., Bridgeport, Conn., manufacturers of valves, gauges, safety valves and control instruments for industrial plants, announce an increase in the general field organization of 25 per cent.

Nine new general salesmen will complete their factory training and be assigned territories February first. This one-fourth increase in the sales force will permit smaller territories and more complete coverage. "In periods of retarded buying we have found that more calls must be made in order to maintain the same sales volume. Our enlarged sales force will enable us to call on more new prospects and our present ones more frequently," said W. P. Bradbury, General Sales Manager.

"A similar policy has been in effect in the development and manufacturing departments of Manning, Maxwell & Moore. For example our records of 1937 show that seventy cents out of every dollar's worth of goods sold last year were products we did not have in 1931. A further study of our records shows that in 1930, 80% of all of our business came from one hundred customers. Today we have literally thousands of new accounts buying our new products. That this aggressive policy in development, manufacturing and sales efforts has already been proven successful is shown by the fact that in 1937 our sales were five times what they were in 1932."

Metal Market Review

January 24, 1938.

Copper had a variable, haphazard time since last reported here. Beginning at 10.125c per pound electrolytic delivered Connecticut Valley, it was raised on January 5th to 10.25c and then, during the following week, as high as 10.875c. On January 18, however, it reacted to 10.75 and on the 19th to 10.50. The present figure is 10.25. Sales followed the trend of the prices, being week by week, 4,215 tons, 12,710 tons and 5,165 tons, a total of 22,090 tons, compared with 30,056 tons for the previous 6 week period. Domestic sales during December amounted to 26,504 tons against 21,035 tons in November.

December statistics were not encouraging. Domestic stocks of refined metal increased 38,232 tons to a total of 259,908 tons. Domestic stocks of blister increased 870 tons. World stocks of refined metal increased 57,906 tons to a total of 471,752 tons. The atmosphere at this time is not bullish.

LATE FLASH: Copper was cut to 10c on Jan. 28th.

Zinc prices remain unchanged although the spirit of the market varied in sympathy with the copper situation, namely quiet the first week, much more active the second and slackening off again during the third.

Stocks of refined zinc increased 22,242 tons in December to a total of 64,776 tons. Shipments to consumers dropped to 29,545 tons for December compared with 32,676 tons in November. Unfilled orders at the end of December amounted to 48,339 tons compared with a high of 106,187 tons.

Prospects at this time are rather dullish.

Lead swam strongly against the current. Beginning at 4.60c per pound E. St. Louis, it was increased on January 7 to 4.70 and a few days later to 4.75, where it now rests steadily. Sales were 4,439 tons, 14,964 tons and 8,634 tons, a total of 28,008 tons compared with 14,935 tons for the previous six-week period. Stocks of refined lead rose 15,558 tons in December, to a total of 129,131 tons.

Sentiment at this time is somewhat mixed, with the market irregular in demand, although steady in price.

Tin fluctuated aimlessly within narrow limits. The first week was rather dull, ranging toward 41 and 42c per lb. Straits, New York. The second week was much stronger, the price rising to 43c and the third weaker, the price receeding to the present figure, 41.25. At this time sellers are somewhat reserved, feeling that the stocks of tin are gradually being worked into a better position.

Silver recovered sharply immediately after the establishment of the price of 64.64c per oz. Troy by the U. S. Treasury for newly-mined domestic silver. While the N. Y. official price remains at 44.75, the "industrial base price" established by Handy & Harman for foreign metal, which had slipped to 43.375 rose again to 44. At this time the "industrial price" is no longer quoted and the N. Y. official continues unchanged at 44.75 with the tone steady.

World silver production was 276,000,000 ounces compared with 250,700,000 ounces in 1936, according to the estimate by Handy & Harman.

Scrap Metals advanced during the first week in January and continued their advance more steeply in the second, but eased off during the third week. This movement applied about equally to copper, brass and aluminum scrap. Brass ingots were in better demand for the first two weeks and then fell off during the third, while the call for secondary aluminum ingot was dull throughout.

On January 1st the unfilled orders on the books of the members of the Non-Ferrous Ingot Metal Institute amounted to 11,276 net tons compared with 13,936 on December 1st and 15,557 tons on November 1st.

The combined deliveries of brass and bronze ingots and billets of the members for the month of December 1937 amounted to total of 3,946 tons compared with 3,805 tons in November and 5,430 tons in October. The Institute reports the average prices per pound received by its members on commercial grades of six principal mixtures of ingot brass during the 28-day period ending January 21st as follows:

	4 wks. end. Jan. 21
80-10-10	12.770
78% Metal	10.250
81% Metal	10.595
83% Metal	10.702
85% Metal	11.040
No. 1 Yellow	9.039

Metal Prices, January 27, 1938

(Import duties and taxes under U. S. Tariff Act of 1930, and Revenue Act of 1932)

New Metals

COPPER: Lake, 10.625, Electrolytic, 10.25, Casting, 9.775.
ZINC: Prime Western, 5.00. Brass Special, 5.10.
TIN: Straits, 40.375. LEAD: 4.75.
ALUMINUM: 20. ANTIMONY, 15.625.
NICKEL: Shot, 36. Elec., 35.
QUICKSILVER: Flasks, 75 lbs., $79-81. BISMUTH, $1.00.
CADMIUM, $1.35. SILVER, Troy oz., official price, N. Y., Jan. 27, 44¾c.
GOLD: Oz. Troy, Official U. S. Treasury price $35.00.
SCRAP GOLD, 6¾c. per pennyweight per karat, dealers' quotation.
PLATINUM, oz. Troy $33-35.

Duties: Copper, 4c. lb.; zinc, 1¾c. lb.; tin, free; lead, 2⅛c. lb.; aluminum, 4c. lb.; antimony, 2c. lb.; nickel, 3c. lb.; quicksilver, 25c. lb.; bismuth, 7½%; cadmium, 15c. lb.; cobalt, free; silver, free; gold, free; platinum, free.

Ingot Metals and Alloys

	Cents lb.	Duty	U. S. Import Tax*
No. 1 Yellow Brass	8.75	None	4c. lb.[1]
85-5-5-5	10.75	None	4c. lb.[1]
88-10-2	14.25	None	4c. lb.[1]
80-10-10	12.50	None	4c. lb.[1]
Manganese Bronze (60,000 t. s. min.)	10.75	None	4c. lb.[1]
Aluminum Bronze	15.00	None	4c. lb.[1]
Monel Metal Shot or Block	28	25% a. v.	None
Nickel Silver (12% Ni)	12.75	20% a. v.	4c. lb.[1]
Nickel Silver (15% Ni)	15.00	20% a. v.	4c. lb.[1]
No. 12 Aluminum	16.25-19	4c. lb.	None
Manganese Copper, Grade A (30%)	24-29	25% a. v.	3c. lb.[1]
Phosphor Copper, 10%	15.00	3c. lb.	4c. lb.[1]
Phosphor Copper, 15%	16.00	3c. lb.	4c. lb.[1]
Silicon Copper, 10%	21.50	45% a. v.	4c. lb.[1]
Phosphor Tin, no guarantee	50-60	None	None
Iridium Platinum, 5% (Nominal)	$36	None	None
Iridium Platinum, 10% (Nominal)	$38	None	None

*** Duty is under U. S. Tariff Act of 1930; tax under Section 60 (7) of Revenue Act of 1932.**
[1] On copper content. [2] On total weight. "a. v." means ad valorem.

Old Metals

Dealers' buying prices, wholesale quantities:

	Cents. lb.	Duty	U. S. Import Tax
Heavy copper and wire, mixed	6½ to 6⅝	Free	4c. per pound on copper content
Light copper	5⅝ to 5⅞	Free	
Heavy yellow brass	4¼ to 4⅜	Free	
Light brass	3 to 3¼	Free	
No. 1 composition	6⅛ to 6⅜	Free	
Composition turnings	5⅜ to 5⅝	Free	
Heavy soft lead	3⅞ to 4⅛	2⅛c. lb.	None
Old zinc	2½ to 2¾	1½c. lb.	
New zinc clips	3¼ to 3½	1½c. lb.	
Aluminum clips (new, soft)	13½ to 14	4c. lb.	
Scrap aluminum, cast	8½ to 9	4c. lb.	
Aluminum borings—turnings	6½ to 6¾	4c. lb.	
No. 1 pewter	21 to 23	Free	
Electrotype	4¼ to 4½	2⅛c. lb.*	
Nickel anodes	29 to 30	10%	
Nickel clips, new	30 to 31	10%	
Monel scrap	7½ to 13½	10% av.	

*** On lead content.**

Wrought Metals and Alloys

The following are net BASE PRICES per pound, to which must be added extras for size, shape, quantity, packing, etc., or discounts, as shown in manufacturers' price lists, effective since Jan. 28, 1938. Basic quantities on most rolled or drawn brass and bronze items below are from 2,000 to 5,000 pounds; on nickel silver, from 1,000 to 2,000 pounds.

Copper Material

	Net base per lb.	Duty*
Sheet, hot rolled	18⅛c.	2½c. lb.
Bare wire, soft, less than carloads	14⅛c.	25% a. v.
Seamless tubing	18⅝c.	7c. lb.

*** Each of the above subject to import tax of 4c. lb. in addition to duty under Revenue Act of 1932.**

Nickel Silver

Net base prices per lb. (Duty 30% ad valorem.)

Sheet Metal		Wire and Rod	
10% Quality	26½c.	10% Quality	29⅛c.
15% Quality	28⅝c.	15% Quality	33½c.
18% Quality	29⅞c.	18% Quality	36¾c.

Aluminum Sheet and Coil

(Duty 7c. per lb.)

Aluminum sheet, 18 ga., base, carload lots, per lb.	33.00c.
Aluminum coils, 24 ga., base price, carload lots, per lb.	28.50c

Rolled Nickel Sheet and Rod

Net Base Prices

Cold Drawn Rods	50c.	Standard Cold Rolled Sheet	49c.
Hot Rolled Rods	45c.		

Monel Metal Sheet and Rod

Hot Rolled Rods (base)	35c.	No. 35 Sheets (base)	37c.
Cold Drawn Rods (base)	40c.	Std. Cold Rolled Sheets (base)	39c.

Silver Sheet

Rolled sterling silver (Jan. 27) 47c. per Troy oz. upward according to quantity. (Duty, 65% ad valorem.)

Brass and Bronze Material

	Yellow Brass	Red Brass 80%	Comm'l. Bronze	Duty	
Sheet	16⅝c.	17⅜c.	18¼	4c. lb.	U. S. Import Tax 4c. lb. on copper content.
Wire	16⅞c.	17⅝c.	18⅜	20%	
Rod	12⅝c.	17⅝c.	18¼	4c. lb.	
Angles, channels	25⅛c.	25⅞c.	26⅝	12c. lb.	
Seamless tubing	19⅜c.	19⅞c.	20⅝	8c. lb.	
Open seam tubing	25⅛c.	25⅞c.	26⅝	20% a. v.	

Tobin Bronze and Muntz Metal

Net base prices per pound. (Duty 4c. lb.; import tax 4c. lb. on copper content.)

Tobin Bronze Rod	18½c.
Muntz or Yellow Rectangular and other sheathing	19⅞c.
Muntz or Yellow Metal Rod	16 c.

Zinc and Lead Sheet

	Cents per lb. Net Base	Duty
Zinc sheet, carload lots standard sizes and gauges, at mill, less 7 per cent discount	10.00	2c. lb.
Zinc sheet, 1200 lb. lots (jobbers' prices)	11.00	2c. lb.
Zinc sheet, 100 lb. lots (jobbers' prices)	15.00	2c. lb.
Full Lead Sheet (base price)	8.00	2⅜c. lb.
Cut Lead Sheet (base price)	8.25	2⅜c. lb.

Block Tin, Pewter and Britannia Sheet

(Duty Free)

This list applies to either block tin or No. 1 Britannia Metal Sheet, No. 23 B. & S. Gauge, 18 inches wide or less; prices are all f. o. b. mill:

500 lbs. over	15c. above N. Y. pig tin price
100 to 500 lbs.	17c. above N. Y. pig tin price
Up to 100 lbs.	25c. above N. Y. pig tin price
Up to 100 lbs.	25c. above N. Y. pig tin price

Supply Prices on page 108.

Supply Prices, January 27, 1938

Anodes

Prices, except silver, are per lb. f.o.b., shipping point, based on purchases of 2,000 lbs. or more, and subject to changes due to fluctuating metal markets.

COPPER: Cast	20⅛c. per lb.
Electrolytic, full size, 15⅛c. cut to size	15⅛c. per lb.
Rolled oval, straight, 16⅛c.; curved	16⅝c. per lb.
BRASS: Cast	18⅞c. per lb.
ZINC: Cast	11¼c. per lb.
NICKEL: 90-92%, 16" and over	.45 per lb.
95-97%, 16" " "	.46 per lb.
99%+cast, 16" and over, 47c.; rolled, depolarized, 16" and over, 48.	

SILVER: Rolled silver anodes .999 fine were quoted Jan. 27, from 48c. per Troy ounce upward, depending on quantity.

White Spanish Felt Polishing Wheels

Diameter	Thickness Under ½"	½-15/16"	1-2"	2-3½"	Over 3½"
Under 1"	6.35-6.40	6.20-6.25	6.10-6.15	6.10-6.15	6.35-6.40
1" to 1 7/16"	5.85	5.70	5.60	5.60	5.85
1½" to 3 15/16"	5.55	5.35-5.40	5.30-5.35	5.30-5.35	5.60
4-5 15/16"	4.95-5.00	4.70-4.85	4.65-4.75	4.65-4.75	4.95-5.00
6", 8" & 9"	3.80-4.25	3.45-3.95	2.45-3.05	2.45-3.00	2.90-3.35
10" to 18"	3.80-4.25	3.45-3.95	2.45-2.95	2.45-2.85	2.90-3.25
Over 18"	3.80-4.25	3.45-3.95	2.70-3.05	2.70-3.00	2.90-3.35

Prices above are for less than 50 lb. For 50 to 99 lb. deduct from 30c per lb. to 5% from list; for 100 lb. and over deduct from 50c per lb. to 10%.

ODD DIAMETERS: (7" & 11" to 17"). Less than 50 lb. add 40c per lb. to above "Even Diameters" list. 50 lb. or over—all one size and consistency and in one shipment—same as "Even Diameters" list above.

On grey Mexican wheels deduct 10c per lb. from above prices.

Cotton Buffs

Full disc open buffs, per 100 sections when purchased in lots of 100 or less are quoted:

16" 20 ply 84/92 Unbleached	$75.24
14" 20 ply 84/92 Unbleached	57.67
12" 20 ply 84/92 Unbleached	43.28
16" 20 ply 80/92 Unbleached	63.28
14" 20 ply 80/92 Unbleached	48.57
12" 20 ply 80/92 Unbleached	36.52
16" 20 ply 64/68 Unbleached	59.69
14" 20 ply 64/68 Unbleached	45.84
12" 20 ply 64/68 Unbleached	34.49

⅜" Sewed Buffs, per lb., bleached or unbleached 54c to 90c

Chemicals

These are manufacturers' quantity prices and based on delivery from New York City.

Acetone C. P. l.c.l. Drums	lb.	.06¼
Acid—Boric (Boracic) granular, 99½+% ton lots	lb.	.05¼-.05¾
Chromic, 100 lb. and 400 lb. drums		.16¾-.17¼
Hydrochloric (Muriatic) Tech., 20 deg., carboys	lb.	.027
Hydrochloric, C. P., 20 deg., carboys	lb.	.08
Hydrofluoric, 30%, bbls.	lb.	.07-.08
Nitric, 36 deg., carboys	lb.	.06
Nitric, 42 deg., carboys	lb.	.07½
Sulphuric, 66 deg., carboys	lb.	.02½
Alocohol—Butyl, drums (f.o.b. destination)	lb.	.10-.10½
Denatured, carloads (f.o.b. prod. pts.)	gal.	.35-.40
Alum—Lump, barrels	lb.	.0340-.0365
Powdered, barrels	lb.	.0355-.0380
Ammonia, aqua, com'l., 26 deg., drums, carboys	lb.	.02½-.05¼
Ammonium—Sulphate, tech., bbls.	lb.	.03½-.05
Sulphocyanide, technical crystals, kegs	lb.	.55-.58
Arsenic, white kegs	lb.	.04½-.05
Asphaltum, powder, kegs	lb.	.23-.41
Benzol, pure, drums	gal.	.41
Borax, granular, 99½+%, ton lots	lb.	.0255-.0305
Cadmium oxide, 50 to 1,000 lbs.	lb.	1.35
Calcium Carbonate (Precipitated Chalk), U. S. P.	lb.	.05¾-.07½
Carbon Bisulphide, drums	lb.	.05¾-.06
Chrome, Green, commercial, bbls.	lb.	.22
Chromic Sulphate, drums	lb.	.26¼
*Copper—Acetate (Verdigris)	lb.	.25
Carbonate, 53/55% cu., bbls.	lb.	.15¼-.16¼
Cyanide (100 lb. kgs.)	lb.	.37
Sulphate, tech., crystals, bbls.	lb.	.052
Cream of Tartar Crystals (Potassium Bitartrate)	lb.	.20¼-.20½
Crocus Martis (Iron Oxide) red, tech., kegs	lb.	.07
Dextrin, yellow, kegs	lb.	.05-.08
Emery Flour (Turkish)	lb.	.07
Flint, powdered	ton	30.00
Fluorspar, bags	lb.	.03½
*Gold Chloride	oz.	$18¼-23
*Gold Cyanide, Potassium 41%		$15.45
*Gold Cyanide, Sodium 46%		$17.10
Gum—Sandarac, prime, bags	lb.	.50
Shellac, various grades and quantities	lb.	.21-.31
Iron Sulphate (Copperas), bbls.	lb.	.016
Lead—Acetate (Sugar of Lead), bbls.	lb.	.11-.13¾
Oxide (Litharge), bbls.	lb.	.12½
Lime Compositions for Nickel	lb.	.09½-.11
Lime Compositions for Brass	lb.	.09½-.11
Mercury Bichloride (Corrosive Sublimate)	lb.	$1.58
Methanol, (Wood Alcohol) Pure, drums l.c.l.	gal.	.40½
Nickel—Carbonate, dry bbls.	lb.	.36-.41
Chloride, bbls.	lb.	.18-.22
Salts, single, 425 lb. bbls.	lb.	.13½-.14½
Salts, double, 425 lb. bbls.	lb.	.13½-.14½
Paraffin	lb.	.05-.06
Phosphorus—Duty free, according to quantity	lb.	.35-.40
Potash Caustic Electrolytic 88-92% broken, drums	lb.	.07¼-.08⅝
Potassium—Bichromate, casks (crystals)	lb.	.09¼
Carbonate, 98-100%	lb.	.06¾
Cyanide, 165 lbs. cases, 94-96%	lb.	.59
Pumice, ground, bbls.	lb.	.03
Quartz, powdered	ton	$30.00
Rosin, bbls.	lb.	.04½
Sal Ammoniac (Ammonium Chloride) in bbls.	lb.	.05-.07½
*Silver—Chloride, dry, 100 oz. lots	oz.	.36½
Cyanide, 100 oz. lots	oz.	.44
Nitrate, 100 ounce lots	oz.	.31½
Soda Ash, 58%, bbls.	lb.	.0235
Sodium—Cyanide, 96 to 98%, 100 lbs.	lb.	.17½-.22
Hyposulphite, kegs, bbls.	lb.	.03½-.06½
Metasilicate, granular, bbls.	lb.	3.15
Nitrate, tech., bbls.	lb.	.0325
Phosphate, tribasic, tech., bbls.	lb.	.03
Silicate (Water Glass), bbls.	lb.	.01½
*Stannate, drums	lb.	.28-.31
Sulphocyanide, drums	lb.	.30-.35
Sulphur (Brimstone), bbls.	lb.	.02¾
*Tin Chloride, 100 lb. kegs	lb.	.34
Tripoli, powdered	lb.	.03
Trisodium Phosphate—see Sodium Phosphate.		
Wax—Bees. white, ref. bleached	lb.	.60
Yellow, No. 1	lb.	.45
White Silica Compositions for Brass	lb.	.07½-.10
Whiting, Bolted	lb.	.02½-.06
Zinc—Carbonate, bbls.	lb.	.14-.15
Cyanide (100 lb. kegs)	lb.	.36
Chloride, drums, bbls.	lb.	.065
Sulphate, bbls.	lb.	.0405

* Subject to fluctuations in metal prices.

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Business Manager

ADOLPH BREGMAN
Managing Editor

PALMER H. LANGDON
Assistant Editor

JOAN TRUMBOUR
Advertising Manager

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